MODERN PLASTICS

JANUARY 1946

IRONING OUT A MATERIALS PROBLEM

A typical "postwar" item is this Silex Steam Iron illustrated. Like so many new products which are a part of our long-awaited civilian economy, this revolutionary home appliance makes prudent use of Durez phenolic plastics.

Why Plastics?

Notice the eye-appealing, heat-resistant handle. Exhaustive tests proved that plastics were better suited for this purpose than any other material known. Their use resulted not only in a better finished product but also in a product which could be produced very economically.

Why Phenolic Plastics?

Of all plastics, the phenolics are the most versatile. Naturally, this makes them the logical starting point for the design engineer with a materials problem. The handle of this Silex Steam Iron, for example, called for heat resistance, smart appearance, pleasant and hand-fitting "feel," moisture resistance, and excellent moldability . . . all inherent characteristics of phenolic plastics.

Why Durez Phenolic Plastics?

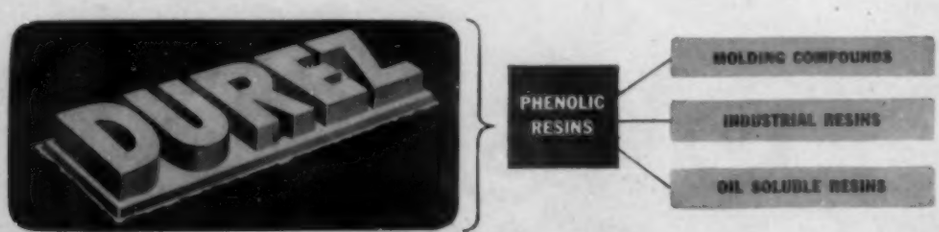
The more than 300 multi-propertied Durez phenolic molding compounds available today are the direct result of a quarter century's continuing research and product development on the part of Durez laboratory technicians. This rich background and the high quality of the materials themselves are convincing reasons why manufacturers in every field of industry look to Durez for the plastics that fit their jobs.

Experienced Assistance Available

Do you have a plastic materials problem? If so, see your custom molder. Wartime developments have endowed him with many new molding methods and processes so that his services are even more valuable than before. Should further assistance be necessary, the competent advice of experienced Durez service engineers and a wealth of proved product development data await your request.

Durez Plastics & Chemicals, Inc., 2613 Walck Road, North Tonawanda, N. Y.

Export Agents: Omni Products Corporation, 40 East 34th Street, New York 16, N. Y.



PLASTICS THAT FIT THE JOB

IN LIGHTER ROLES, TOO Catalin IS "BOX OFFICE"!
The Gem of Plastics
These, ladies and gentlemen, are your new Cambridge Lighters*—encased by the exquisite and incomparable beauty of Catalin, the gem of plastics. To the eye, they are Catalin at its finest . . . each case is distinctive, as richly hued as a jewel. To the hand, they are Catalin at its best . . . highly polished, warm to the fingers, luxurious to the grasp. To the maker, they are Catalin at its fittest . . . cast to specification, dimensionally stable, readily fabricated, non-inflammable and (equally important), inert to the chemical action of lighter fuels.
The selection of Catalin for the leading or supporting role in any product design pre-assures sales appeal. Should you like to discuss Catalin's potentials, as they apply to your own particular product, our staff welcomes your inquiry.
*Distributed by
J. J. SPERANS CO.
Empire State Bldg.
New York, N. Y.
CATALIN CORPORATION · ONE PARK AVE., NEW YORK 16, N.Y.
Catalin
CAST RESINS · LIQUID RESINS · MOLDING COMPOUNDS

MODERN PLASTICS

AND PLASTICS

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Member Audit Bureau of Circulations

Shoe parts made from Geon . . . suggest many other interesting applications

New material adds permanent beauty —lengthens shoe life

THOSE strips of shoe trim material in the picture look ordinary enough—but actually they're revolutionary. For GEON polyvinyl materials have made possible completely new techniques in shoe styling and manufacture. The GEONS are thermoplastic raw materials that can be extruded (as these strips were), pressure or injection molded, cast or calendered into sheet or film, or used as coatings for fabric and paper.

As a shoe material GEON can be used for trim, soles, heels, welts and ribs, toe caps and liners. These and other products made from GEON can be brilliantly or delicately colored. They can be given a smooth or embossed surface, a dull or mirror finish. They won't crack or check because they are so highly resistant to aging. They are easy to clean because dirt and water —even corrosive acids—can't penetrate the surface.

All these and many more unusual properties can be considered in connection with a wide variety of products other than shoes: scuffproof, good-looking, practically indestructible luggage and brief cases; upholstery material that can be left outdoors because it resists the aging effects of weather; water and mildewproof fabric coatings for rainwear, shower curtains, tents; film, sheet, or coatings of GEON for packages that will resist wear, aging, chemicals, foods, tobacco, oils and greases, moisture, heat and cold.

There are applications for GEON in every phase of American life. For more complete information write Dept. I-1, B. F. Goodrich Chemical Company, 324 Rose Building, Cleveland 15, Ohio.

Geon
Polyvinyl Materials

B. F. Goodrich Chemical Company

A DIVISION OF THE B. F. GOODRICH COMPANY

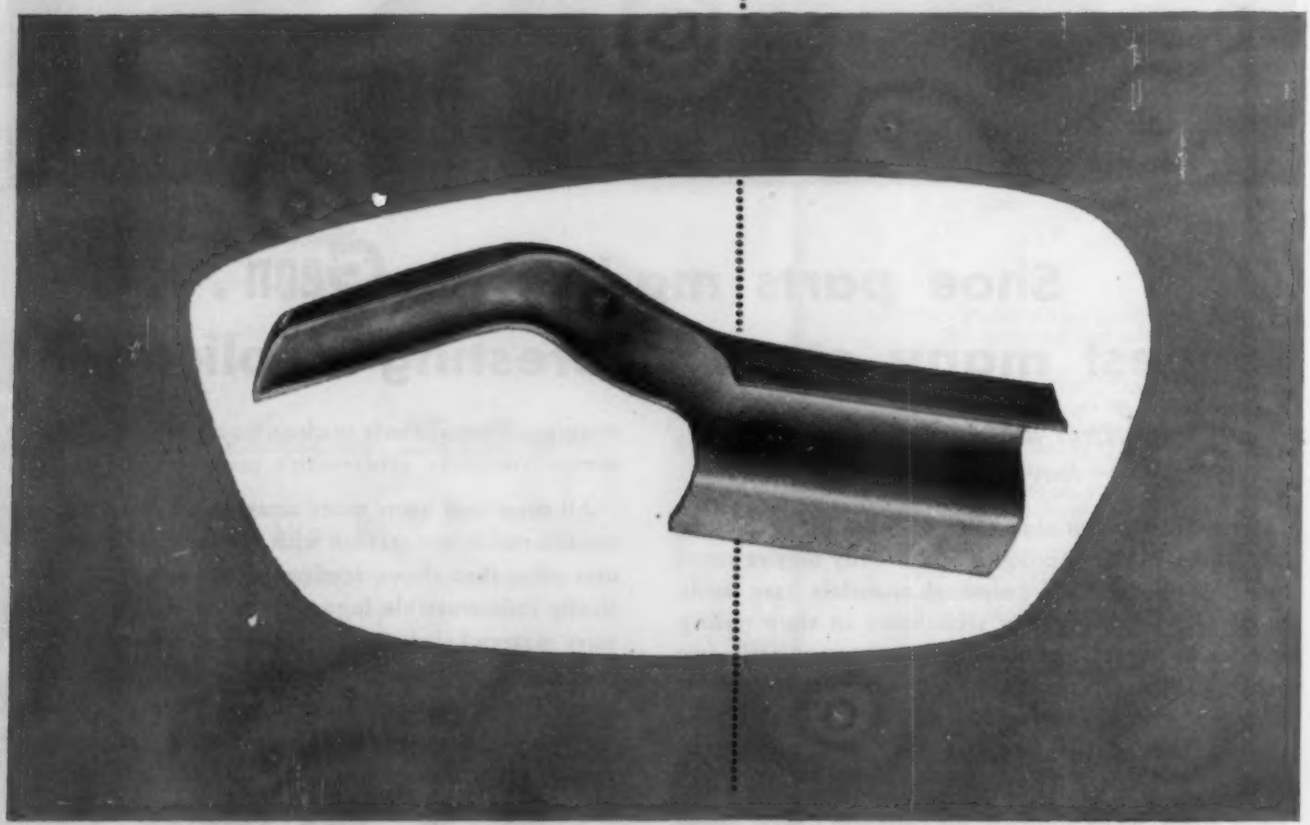
Case Histories from the **RICHARDSON** *files*

POST FORMED LAMINATED PRODUCTS

Problem: *Produce an aircraft cable guard for use where the cost of hand-working metal is prohibitive. Must be light, strong, and rigid.*

Solution: *Richardson Plasticians* used laminated thermosetting post forming materials. Specially designed tools, plus precision production methods, resulted in a Laminated INSUROK cable guard that is light, strong, and economical.

Why not discuss your product design plans with The Richardson Company? Here you will find the expert personnel, diversified facilities, and manufacturing skill to help solve your plastics problems—whatever they may be. Write today for full details.



INSUROK *Precision Plastics*

The RICHARDSON COMPANY

LOCKLAND, CINCINNATI 15, OHIO FOUNDED 1858 *Sales Headquarters:* MELROSE PARK, ILL.

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DETROIT: 6-252 G. M. BUILDING, DETROIT 2, MICHIGAN

Factories { MELROSE PARK, ILLINOIS
NEW BRUNSWICK, NEW JERSEY
INDIANAPOLIS 1, INDIANA

HOW TORPEDO VALVE SEATS OF DU PONT NYLON

Gave a tighter fit for a longer time
. . . eliminated need for hand lapping
. . . reduced assembly time and weight

THE OLD WAY: Metal valve seat for U. S. Navy torpedo stop valves had to be hand lapped to fit tightly against air pressure of 2800 p. s. i. Even after lapping, dirt particles often caused leakage. Assembly, overhaul time much greater. Weight: 20 gr.

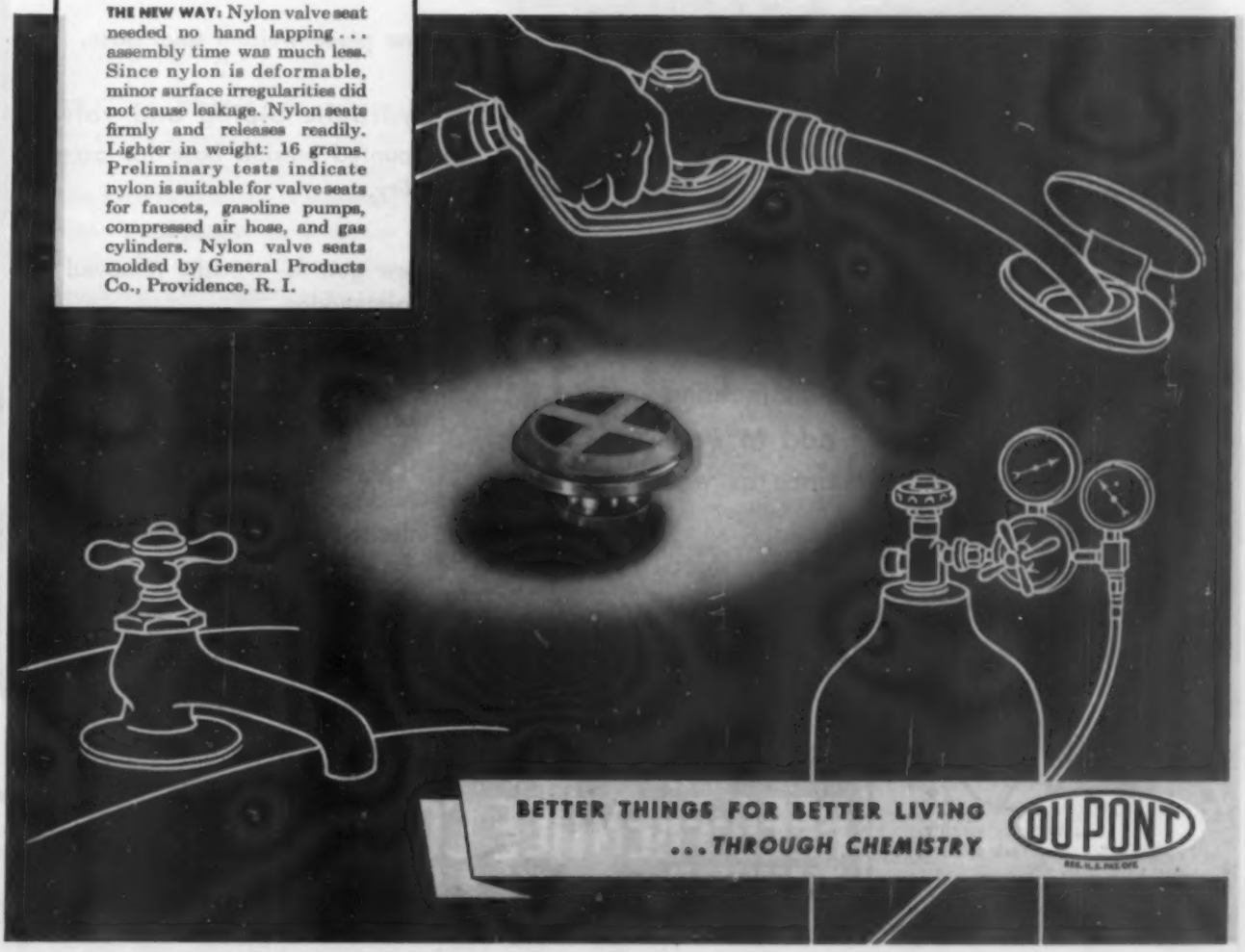
THE NEW WAY: Nylon valve seat needed no hand lapping . . . assembly time was much less. Since nylon is deformable, minor surface irregularities did not cause leakage. Nylon seats firmly and releases readily. Lighter in weight: 16 grams. Preliminary tests indicate nylon is suitable for valve seats for faucets, gasoline pumps, compressed air hose, and gas cylinders. Nylon valve seats molded by General Products Co., Providence, R. I.

When our Navy changed from metal to molded nylon for a vital part of a weapon so important as the torpedo, you can be sure they had compelling reasons. The vital part is the valve seat shown—and here is why nylon is used.

Nylon valve seats gave a tighter, more nearly permanent fit *without* lapping than the metal seats did after long and costly hand lapping. These valves have to hold back an air pressure of 2800 p. s. i. The nylon valve seats conformed to minor surface irregularities . . . did not permit leakage. Elimination of lapping greatly reduced assembly and overhaul time and cost. This reduction, plus the superior job the new valve seat did, outweighed a somewhat higher initial cost.

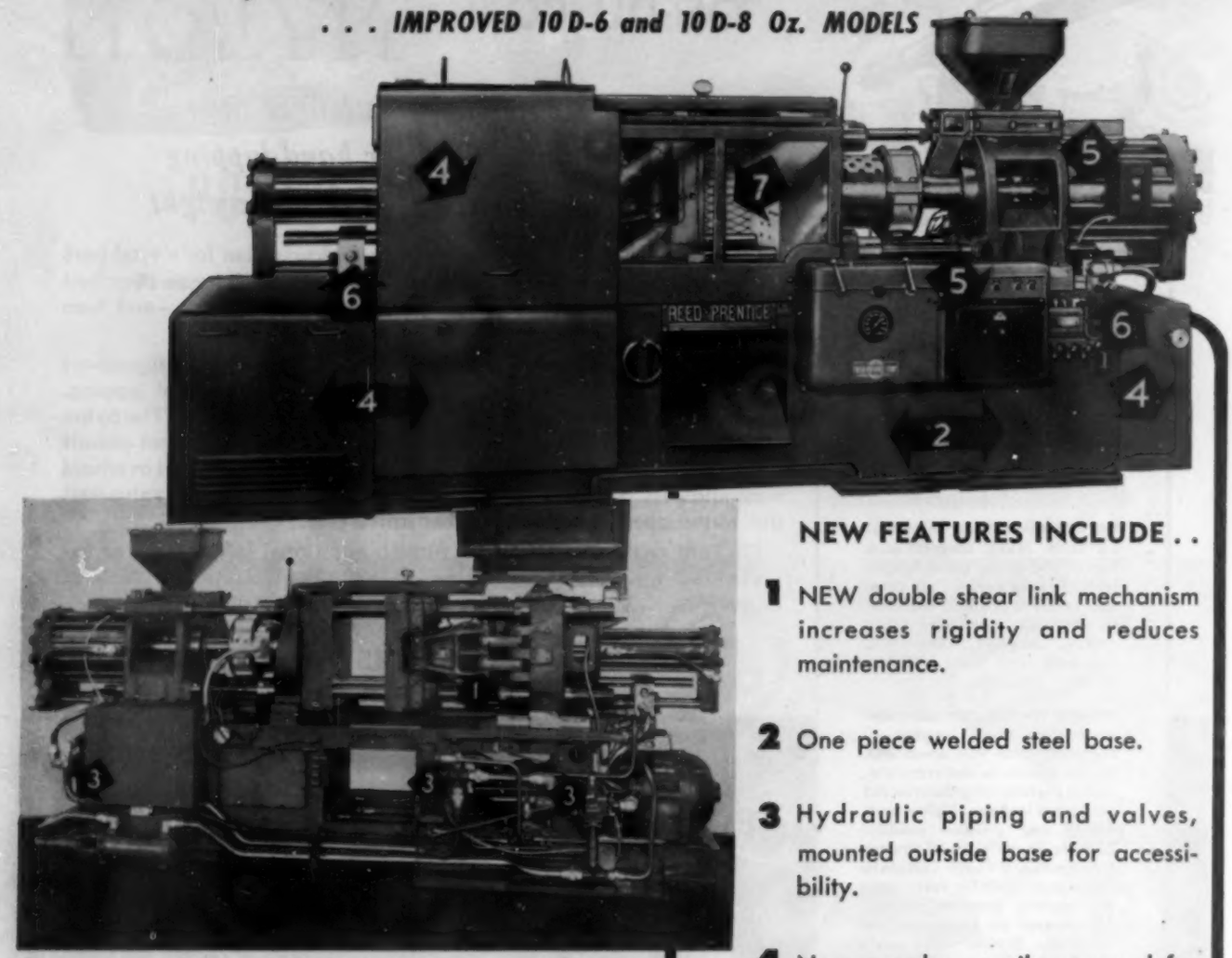
Du Pont engineers will gladly furnish additional information or experimental quantities of nylon or other Du Pont plastics. Write E. I. du Pont de Nemours & Co. (Inc.), Plastics Dept., Arlington, N. J.

FOR PLASTICS . . CONSULT DU PONT



Making the best machine **BETTER!**

. . . IMPROVED 10D-6 and 10D-8 Oz. MODELS



Lower view shows rear of machine with guards removed.

Recent improvements in the 10D-6 and 8 Oz. Reed-Prentice injection molding machines (shown above) add to ease of operation and maintenance as well as to general appearance.

You'll find a machine to fit every injection molding problem — models available in 22, 16, 12, 8, 6 and 4 Oz. sizes.

NEW FEATURES INCLUDE . .

1 NEW double shear link mechanism increases rigidity and reduces maintenance.

2 One piece welded steel base.

3 Hydraulic piping and valves, mounted outside base for accessibility.

4 New guards — easily removed for maintenance.

5 Electric timing clocks, mounted in dust tight boxes.

6 Quick adjustment of clamping and injection units by rack and pinion.

7 Transparent plastic window for safety door.

★ ★ ★ ★ ★

NEW YORK OFFICE:
75 West St., New York 6, N. Y.

INJECTION
REED-PRENTICE CORP.
WORCESTER MACHINES MASS., U.S.A.

★ ★ ★ ★ ★ ★ ★ ★ ★

CLEVELAND OFFICE:
1213 W. 3rd St., Cleveland 13, Ohio

Celanese Corporation of America

Announces

THE FIRST NEW PLASTIC SINCE THE WAR

Forticel†

FORTICEL is a cellulosic thermoplastic. Chemically it is *cellulose propionate*. Physically it possesses what is perhaps the best balance of desirable characteristics obtainable from commercial thermoplastics. Its outstanding properties are toughness, low humidity expansion and brilliant surface finish.

FORTICEL HAS THE CONSUMER APPEAL OF THE CELLULOSICS

Forticel has the color beauty and touch appeal of the cellulosics. It is odorless and non-toxic—ideal for personal contact items—particularly those which are subject to extensive wear.

FORTICEL IS A MOLDER'S PLASTIC

Forticel's excellent molding properties will be important to the designer and manufacturer as well as the molder. Practically invisible weld lines and great weld strength will simplify product design. The injection molding cycle—generally shorter than other cellulosics—and the wide molding temperature range will mean faster and more economical production. Forticel is compatible with cellulose acetate butyrate, but is not miscible with other cellulosics.

The addition of Forticel greatly enlarges the field of usefulness of the Celanese family of thermoplastics. By January first Forticel will be available for tests on selected applications. Increased quantities will be produced as rapidly as new plant facilities can be put into operation. Celanese Plastics Corporation, a division of Celanese Corporation of America, 180 Madison Avenue, New York 16, N. Y.

*Reg. U. S. Pat. Off.
†Trademark

This is Forticel

TOUGHNESS	Exceeds that of any other commercial ester
SURFACE	Brilliant mold finish, requires no polishing
COLOR	Unlimited range
ODOR	None
HUMIDITY EXPANSION	0.4 percent
LIGHTNESS	Specific gravity 1.17 to 1.2
MOLDABILITY	Molding cycle is generally shorter than other cellulosics . . . Uncritical molding temperature range

A Celanese® Plastic

HAVE YOU A PLASTICS PROBLEM?

Our Address is

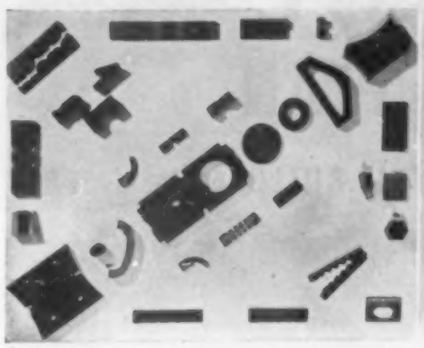
PROLON PLASTICS

A Division of

Pro-phy-lac-tic Brush Co., FLORENCE, MASS.

• PLASTICS

On this page are illustrated practical examples of various services rendered by TECKNA



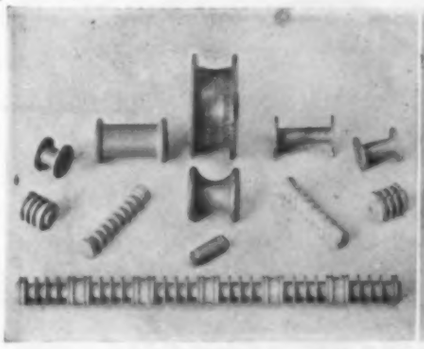
FLAT SHAPES (above) requiring drilling, slotting, countersinking, shaping, engraving or printing in all workable plastics.

Wet process machining of G M G., MYCALEX on other glass filled materials.

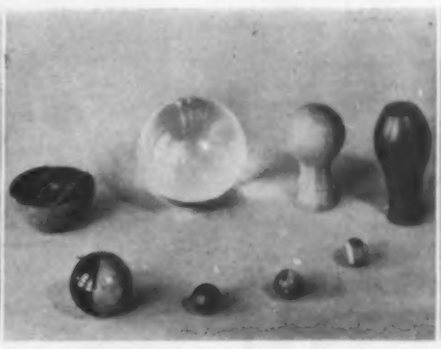
MANUFACTURED PART fabricated from thermoplastics and thermosetting materials—combined with other materials. Also finished products of cast resins and thermoplastics (not illustrated) such as cutlery handles, cabinets, cases, etc.

EXPERIMENTAL PARTS created and engineered to your specifications.

A complete department headed by experienced engineers, designers, tool and die makers, is available for designing experimental parts, models, etc.

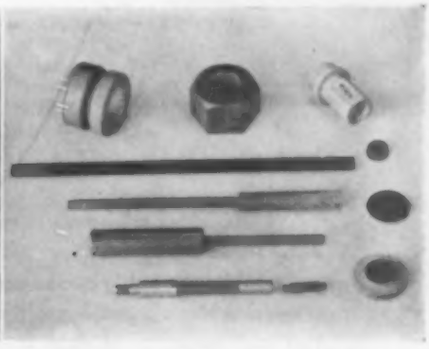


PRECISION FORMING an exclusive, improved process designed and engineered by TECKNA makes possible close tolerance forming in production quantities. Any intricate shapes formed from thermoplastics and thermosetting materials are within the scope of this newly developed machinery. Results



offered by TECKNA have never before been accomplished.

Turned Rods, Pulleys, balls, beads, handles and other industrial and product parts similar to those illustrated *above* and *to left* are available to meet close tolerance.



FINISHED PRODUCTS. Fabricated and assembled products of thermoplastic and thermosetting materials; cast resins; etc., are available.

TECKNA maintains a complete tool room, makes its own dies and molds.

To left is illustrated the administration building of the main plant located at Bayside, L. I.

To right is the new branch factory at West Warren, Mass., devoted to the finishing of cast resins, molding and extruding, etc.

SEND FOR BULLETIN MP

All inquiries considered in strict confidence.

TECKNA company

Fabricators of Plastics

223-01 Northern Boulevard, Bayside, N. Y., BAyside 9-5302

Branch Factory: West Warren, Mass.

TECKNA

From a single piece to a million or more

A *Quality Control* PLAN

TO HELP YOU BUILD CONSUMER CONFIDENCE IN YOUR PLASTIC PRODUCTS

PLASTICS are comparatively new to the consumer. Accelerated by war production, they will appear on the market in numberless new products . . . new applications . . . new uses.

You can't expect consumers to go all out for these untried Plastic products *unless* you take steps to win their confidence.

Here is how we can help you do just that:

Our Certified Merchandise Group includes many of the most famous branded lines of products in this country. These products are tested by us and, if approved, are Certified and awarded our nationally recognized Seal of Quality. After Certification, all products are policed . . . are bought on the open market and check-tested continually as a form of quality insurance.

We invite manufacturers of Plastic products to submit their merchandise to us for Certification. If accepted for the Certified Group, they may be sold as tested and Certified for serviceability by the United States Testing Company, Inc., and may be labelled with the Seal of Quality.

This quality control plan, more than any other single factor, will help build consumer confidence in your Plastic products.

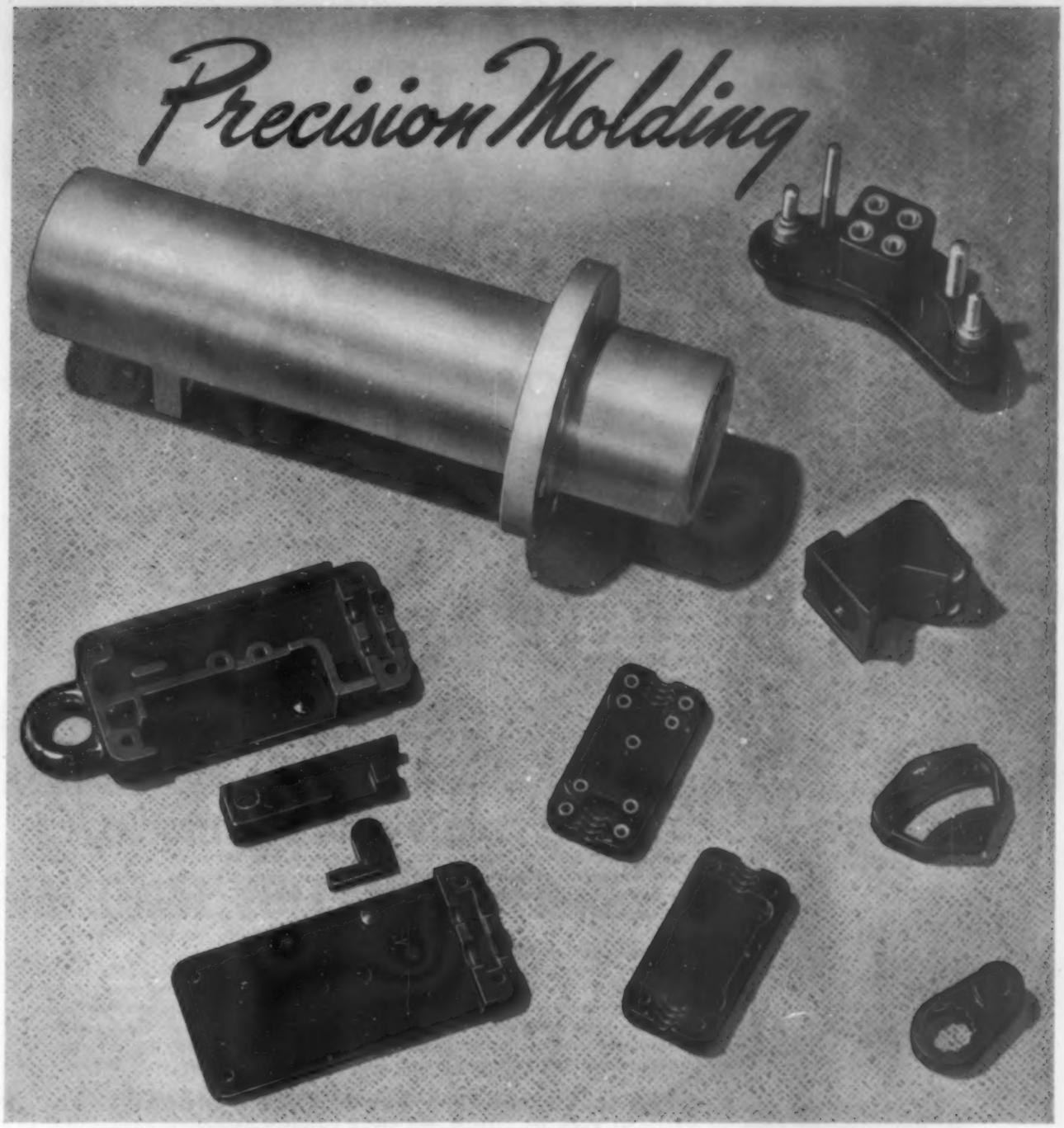
Write for complete details.

UNITED STATES TESTING COMPANY, Inc.

ESTABLISHED 1880

HOBOKEN, NEW JERSEY

PHILADELPHIA, PA. • BOSTON, MASS. • WOONSOCKET, R. I. • CHICAGO, ILL. • NEW YORK, N. Y.



☆ For Mass Production Products ☆

The photo above illustrates merely a few of many shapes and sizes of plastic parts we mold in large and small quantities for all kinds of applications.

We also have mold building facilities at your disposal if desired and we invite your correspondence whatever the nature of your requirements may be.

INTERNATIONAL MOLDED PLASTICS, INC.

4387 WEST 35th STREET, CLEVELAND 9, OHIO

For a Bruiser he was always a "Weary Willie"

He was no weak sister. But that slow, nerve-straining, muscle-cramping drudgery of hand-driving slotted screws kept him a high-cost, low-output worker. In fact, Bill and his whole department were *low* all the time . . . in production, spirits, and health . . .

. . . 'til AMERICAN PHILLIPS SCREWS stopped him from "beating his brains out"

Bill's boss got to analyzing his costs one day . . . found that his screw-driven assembly cost was the *only cost he could cut,* and that there was *only one way to do it.* So he threw out his hand-drivers and slotted screws . . . put in power-drivers and American Phillips Screws.

Now his assembly costs are down 50%. His output is at an all-time high, and so is product-quality. What's more, Bill's department has taken new interest in the job, and no longer bogs down from exhaustion toward the end of the shift. All because American Phillips Screws are:

1. "*Fumble-Proof*" . . . screw and 4-winged bit fit firmly into one straight unit that can't drive any way *but* straight. No wobbly starts, no dropped screws.
2. "*Slip-and-Slash-Proof*" . . . bit and screw can't twist apart till screw is driven up tight and flush. No spoiled work or gashed hands.

Now add a third advantage . . . American's 4-phase quality control that means higher "perfection-percentage" in every shipment of American Phillips Screws . . . and you have your top opportunity for cost-control looking you right in the face! Write.

AMERICAN SCREW COMPANY, PROVIDENCE 1, RHODE ISLAND

Chicago 11: 589 E. Illinois Street *Detroit 2:* 502 Stephenson Building

AMERICAN PHILLIPS *Screws*

Guaranteed Free from Burrs and Split Heads

Strong, lightweight National Vulcanized Fibre serves efficiently in aircraft structural parts, as in this internal brace for self-sealing fuel cells.

resilient...lightweight

NATIONAL VULCANIZED FIBRE

may be your answer to new, profitable products

Just as National Vulcanized Fibre adds to the life and efficiency of structural parts in aircraft—this strong, durable material gives *your* products and equipment longer performance . . . at greater economy.

The unusual strength of National Vulcanized Fibre, combined with its other remarkable properties, makes it a "natural" for countless applications in every industry. Resilient and light in weight (about half that of aluminum), it has outstanding tensile and impact strength . . . excellent machinability and forming qualities . . . is high in dielectric strength . . . is extremely resistant to wear and abrasion . . . and is one of the *strongest* materials per unit weight known.

This versatile material offers you no end of profitable possibilities in your products and plant equipment. Write for complete information now. Let one of our trained technical engineers show you how National Vulcanized Fibre can serve you advantageously in your plant equipment and in your products.

NATIONAL VULCANIZED FIBRE CO.

WILMINGTON, DELAWARE

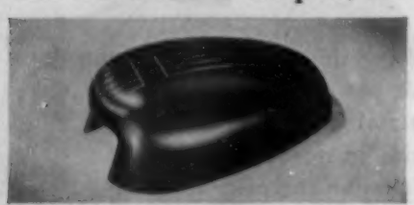
OFFICES IN PRINCIPAL CITIES

Internal Stress ?

We reduce it for better plastic parts

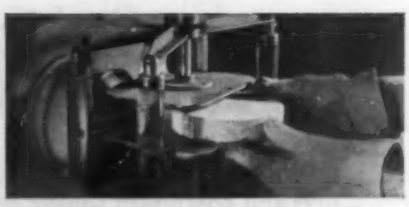
CUTTING 'WAY DOWN on internal stress gives your plastic application greater strength and stability under stress, as well as better dimensional stability under severe temperature change—in many cases, simplifies retention of tolerances when cooling. It produces a far better molded piece.

Like this. With the standard molding practices of a few years ago, molding this vacuum cleaner housing called for a 150 ton press. We produce it now in a 75 ton press, and



get a *better* cure and a finer finish, too. That's Heatronics (radio frequency pre-heating) for you — and only a couple of its many benefits, at that.

Let us show you how Heatronic molding can help *you.* We've been custom molders since the birth of the industry — developers of Heatronics since we pioneered its use in plastic molding. We're large enough and perfectly equipped to handle *any* job —not so large that our top men lose sight of the jobs you give us. Try us and see.



Complete molding facilities — from design to finished product — are at your service here. Just ask for a Kurz-Kasch engineer.

Kurz-Kasch

For Over 28 Years Planners and Molders in Plastics

Kurz-Kasch, Inc., 1415 South Broadway, Dayton 1, Ohio. *Branch Sales Offices:* New York Chicago • Detroit • Los Angeles • Dallas • St. Louis • Toronto, Canada. *Export Offices:* 89 Broad Street, New York City

BAKER
PLASTICIZERS

IMPART

Retained Flexibility

TO

VINYL RESINS — CELLULOSE RESINS

PHENOL FORMALDEHYDE RESINS

MELAMINE RESINS — STYRENE RESINS

UREA FORMALDEHYDE RESINS

AND

GR-S — GR-N — GR-M

THE

BAKER CASTOR OIL COMPANY

Established 1857

120 Broadway, New York 5, New York

Chicago, Illinois — Los Angeles, California

Salute to THE PLASTICS INDUSTRY

During 1944-45, Union Pacific paid tribute to American industry on its radio program "Your America", broadcast each week over a nation-wide network. Representatives of 70 major industries were given the opportunity to present the dramatic story of their respective industry's contribution to the welfare of the nation.

For example, on one program our guest speaker was Frank Carmen of Washington, D. C., representing the Plastics Materials Manufacturers' Association. On another program H. L. Derby of New York City represented the Manufacturing Chemists' Association.

Union Pacific—along with other railroads—was then engaged in moving vital wartime materials. Your industry and the nation generally knows what a tremendous task that was and how efficiently it was accomplished.

Today, Union Pacific is prepared to continue its assistance to your industry by speeding the distribution of peacetime commodities. Equipment, facilities and personnel are geared to provide unexcelled service.

A staff of trained traffic men stand ready at all times to cooperate with you.

For fast, dependable service . . . .

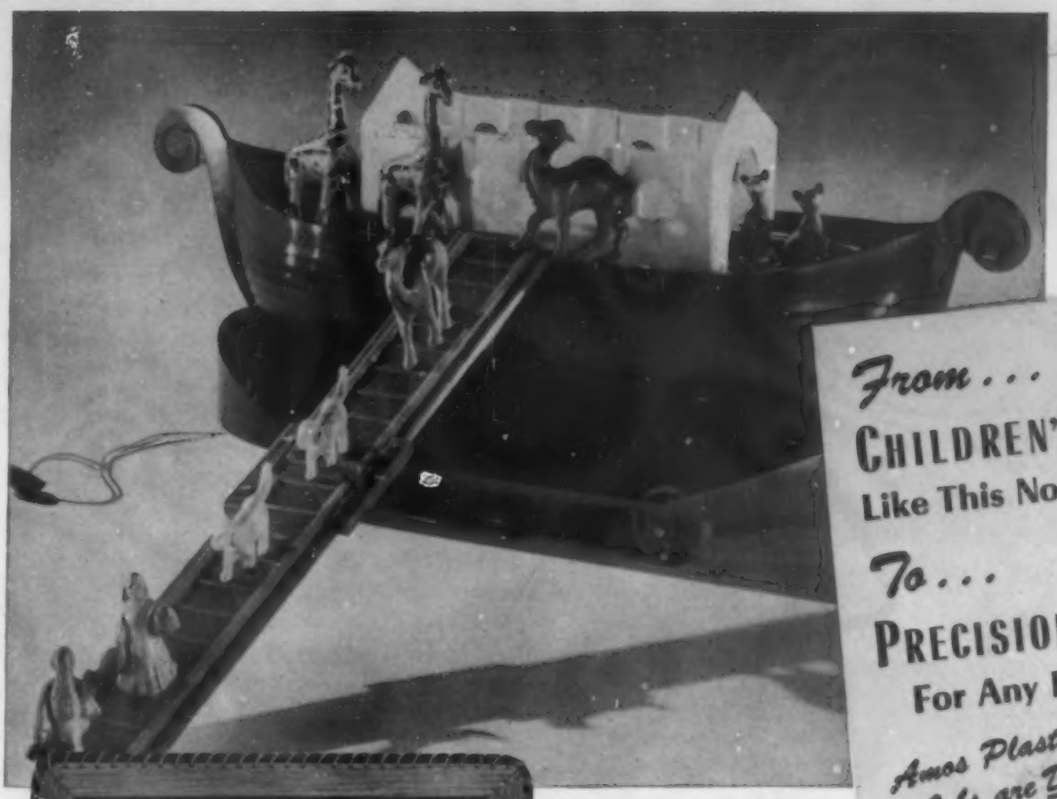
Be Specific— say "Union Pacific"

★ *Union Pacific will, upon request, furnish information about available industrial and mercantile sites in the territory it serves. Address Union Pacific Railroad, Omaha, Nebraska.*

The Progressive

UNION PACIFIC RAILROAD

The Strategic Middle Route



From . . .

CHILDREN'S TOYS

Like This Noah's Ark

To . . .

PRECISION PARTS

For Any Product

Amos Plastic Molding Jobs are Done Right

THIS NOAH'S ARK TOY—size 19" long by 9" high—is a product of Amatoy Corporation, Chicago, Ill. All parts except the animals molded by Amos. Photo by Eastman Kodak Co.

WHETHER YOU NEED

PLASTIC PARTS

FOR ELECTRICAL APPLIANCES

OFFICE MACHINES OR INDUSTRIAL EQUIPMENT

Special Handles and Control Knobs for

TOOLS RADIOS AUTOS PLANES

CASES FOR CLOCKS CAMERAS JEWELRY

BATHROOM FIXTURES MEDICAL ACCESSORIES

Or Anything Else that's a Practical Plastic Application

You Get the Job Done Right by

Amos

MOLDED PLASTICS...

From plastic toys to precision parts Amos does custom molding jobs that go into many different fields. And Amos customers get their jobs done exactly right—the way they want them—from engineering to molding and finishing.

For example the all-plastic Noah's Ark you see above is a recent Amos job for a customer in the toy field. Other jobs going through the new Amos plant include a wide variety of plastic parts and products.

With this new plant—one of the most modern in the industry—Amos facilities for plastic molding have been greatly expanded. You'll get your job done right by Amos. Just send us your drawings or write us what you have in mind to be molded in plastics.

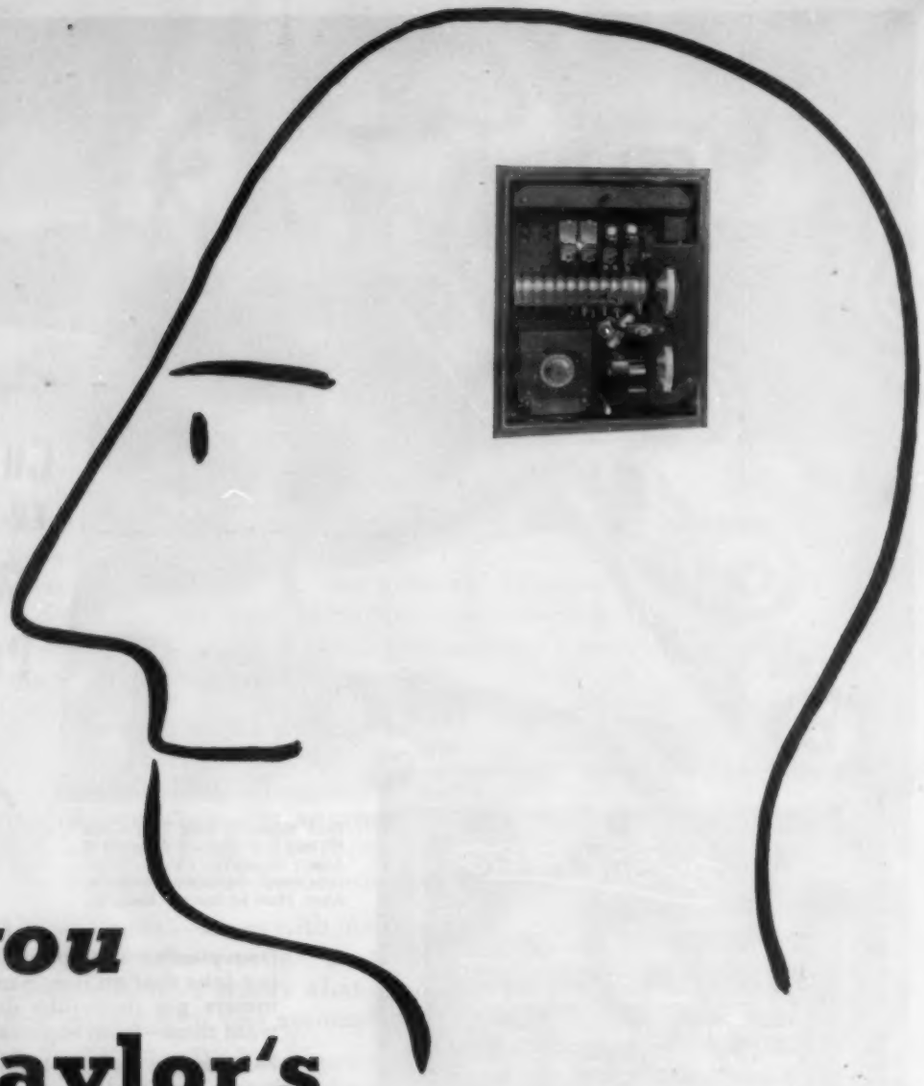
AMOS MOLDED PLASTICS • EDINBURGH, INDIANA

Division of Amos-Thompson Corporation

CUSTOM *Molders of*

Plastic Parts and Products

Injection Molding Specialists



Have *you* tried Taylor's Mechanical Brain?

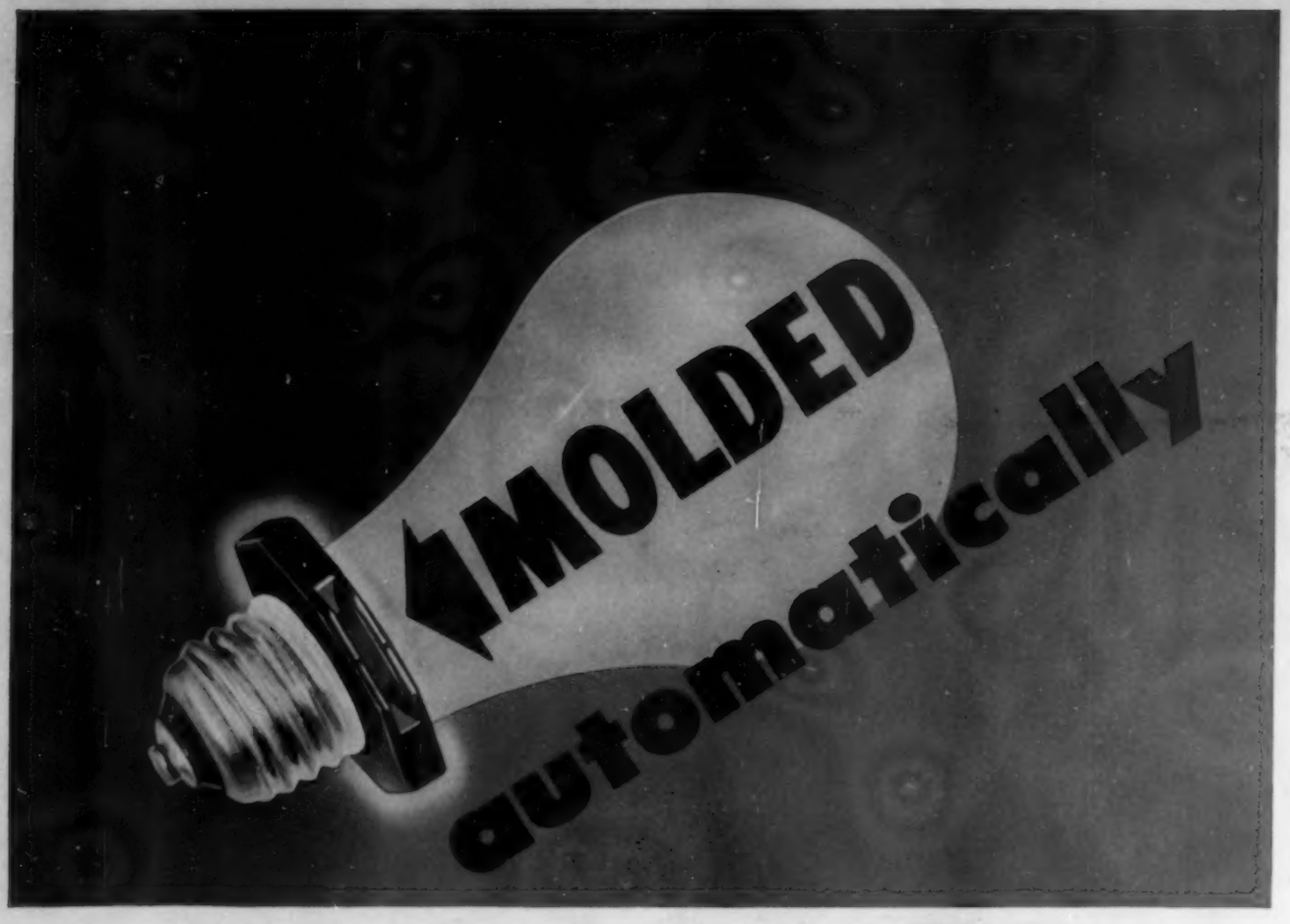
THE Flex-O-Timer has many times demonstrated its ability to take complete charge of *any* Compression Molding hookup—from the simplest to the most complex. All the operator has to do is load the press and push the button to reproduce any ideal schedule *accurately*. Installation can provide for Preheating, Bumping (or gassing), Restripping, Slow Closing or most any other special requirement. For full details, write today for Catalog No. 98154, descriptive of the Flex-O-Timer, or call your Taylor Field Engineer. Taylor Instrument Companies, Rochester, N.Y., and Toronto, Canada. *Instruments for indicating, recording and controlling temperature, pressure, humidity, flow and liquid level.*

ARMY E NAVY

Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

BUY VICTORY BONDS AND KEEP THEM!

Masterpieces
for the millions...
As the great artist creates living beauty with brush and palette, so does Columbia create living beauty with colorful, enduring plastics. Columbia precision-clear sun glasses—one of many such achievements by Columbia master-craftsmen—reflect this unique ability to create masterpieces in plastic for the millions . . . by the million.
COLUMBIA Plastics
COLUMBIA PROTEKTOSITE CO., INC. • CARLSTADT, N. J. • New York Offices • Empire State Building • Room 7013



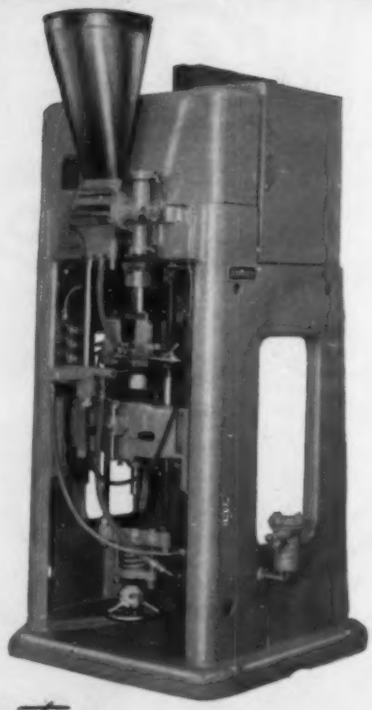
AT SUBSTANTIAL SAVINGS OVER CONVENTIONAL METHODS

When this three-way switch was put into production, both conventional molding methods and Completely Automatic Molding were investigated.

Analysis of all cost figures led to the selection of Completely Automatic Molding on many counts—lower mold cost, more quickly into production, minimum labor and finishing costs.

With Stokes Completely Automatic Presses, cycles are reduced through split-second timing. Flash losses are reduced 8% to 10% and more. Mold costs are low because few cavities do the work of many. Production design changes can be made quickly and economically. Molded parts are uniform, of highest quality, always accurate.

Investigate Completely Automatic Molding.



F. J. STOKES MACHINE COMPANY • 5934 Tabor Road, Philadelphia 20, Pa.

50th year of Service to Industry

F.J.Stokes AUTOMATIC TABLETTING EQUIPMENT FJS Est. 1895

The

VIRGINIA-LINCOLN LINE OF PLASTICS

Will Now be Made by . . .

LINCOLN INDUSTRIES, Inc.

MARION, VIRGINIA

(UNDER SAME MANAGEMENT)

MANUFACTURERS OF

Valin

The Revolutionary New Plastic that Won its Spurs in Wartime Applications

If your job calls for large plastic construction, it's a job for VALIN. Phenomenally strong VALIN proved its strength and stamina in war — the nose of the deadly "Black Widow" night fighter was made of VALIN . . . tough, strong radar field houses were made of VALIN . . . and VALIN served in scores of other vital military uses. Where daily use is hardest, VALIN stands up; where stress is constant, VALIN is dependable; where you need strength combined with light weight, VALIN is your plastic for larger types of construction. Our engineers are ready to tackle your plastic construction problem with VALIN, the versatile low-pressure, reinforced plastic for strength, beauty and wear.

LINCOLN INDUSTRIES, Inc.

MARION, VIRGINIA

VALIN DIVISION

IT'S EASY TO SEE WHY TYBOND GIVES YOU . . . BETTER QUALITY • PRICE • DELIVERY . . . on Molded Plastic Parts

- "Give TYBOND the same specifications and they'll give you better plastic parts—closer tolerances, better appearance, better quality, priced right."
- That's because TYBOND respects your product—makes your parts with more care . . . more care in the mold making, in the molding process itself; more care in the finishing. More inspections—even more care in packing and shipping.
- No brass hats at TYBOND. We're an organization of workers. Your order means a lot to all of us. We team up to fulfill your most exacting specifications on a *timed production basis* that meets your quantity requirements *on promised schedule.*
- Initial deliveries come through sooner because we have our own mold making facilities. We usually get into production faster. Send prints for quotations or tell us your problem. There is no obligation.

TYBOND

Molded Plastics Parts

TYBOND PRODUCTS COMPANY • 2435 N. WESTERN AVE., CHICAGO

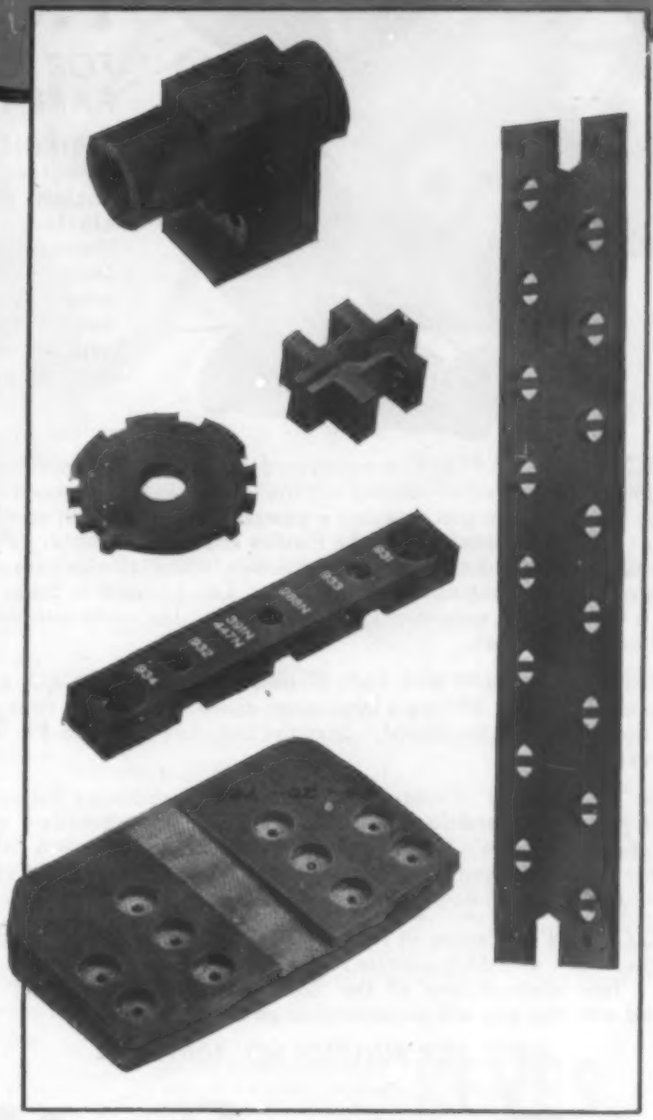
"SMALL ENOUGH TO GIVE YOU PERSONALIZED SERVICE, LARGE ENOUGH TO PRODUCE IN THE MILLIONS."

Use Panelyte Fabricated Parts where corrosion is a Problem

Panelyte laminated plastic parts are not affected by water, brine, oil, ordinary solvents, coolants, ketones, esters, weak acids or alkalis. Having good electrical properties combined with unusual structural strength, dimensional stability, and excellent heat resistance, Panelyte is thoroughly dependable and adaptable. Easily machined to exact specifications, weight-saving Panelyte parts are mass-produced in our new plant.

Our policy of working closely with customers' engineering departments enables us to give designing aid, and from performance data on hand, to make accurate estimates on the service life of proposed applications.

Inquiries are invited on sheets, rods, tubes, and *molded* as well as fabricated parts. Write for factual "Engineering Data Book".



Typical examples of lathe turning, grooving, printing, milling, shaving, and die-punching.

PANELYTE *the structural plastic*

PANELYTE DIVISION
ST. REGIS PAPER COMPANY
230 PARK AVENUE
NEW YORK 17, N. Y.

Sales Offices: Atlanta, Boston, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Kansas City, Los Angeles, Nashville, New Orleans, Phoenix, Portland, St. Louis, St. Paul, San Francisco, Seattle, Syracuse, Trenton; Buenos Aires, Johannesburg, Mexico City, Montreal, San Jose, Sao Paulo, Sydney, Toronto, Vancouver.

★ MASS PRODUCTION OF SHEETS, RODS, TUBES, MOLDED FORMS, FABRICATED PARTS IN PAPER, FABRIC, FIBRE GLASS, ASBESTOS BASE LAMINATES; DECORATIVE GRADES

NO. 13697

New Accurate Fast

PRECISION POLARIZING INSTRUMENTS

FOR OBSERVING STRAINS IN TRANSPARENT PLASTICS AND GLASS!

"PRECISION" Polarizing instruments were developed to determine the amount of strain produced by fabrication, stress or mechanical manipulation of photo-elastic materials. May also be used in identifying transparent plastics, glass and other similar materials and is invaluable in determining strains produced under stress in construction designs of opaque materials by employing a transparent model for testing and observation. Equally valuable in research laboratory or production control.

"PRECISION" Polarizer #13697 is engineered throughout for compactness, sturdiness, simplicity, and speed of operation. The testing sample is viewed through an adjustable binocular eye-piece against a powerful polarized light source, 10" in diameter. Designed especially for the Plastics and Glass Industry. Accommodates various shapes and sizes—normal, two-eye vision eliminates eye fatigue. Adjustable to convenient operating position. Can be used in broad daylight. This unit is shock-proof, water-proof, and rust-proof. The entire assembly is pivot mounted on a sturdy base.

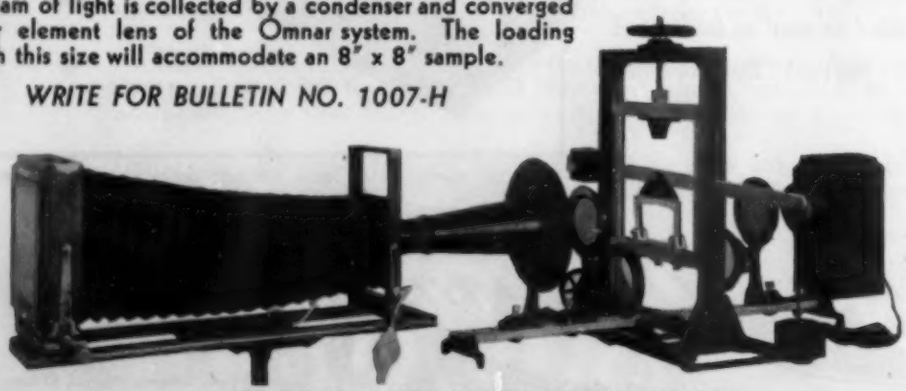
"PRECISION" Polarizer #13698 has a 6" polarized light source with a rectangular eyepiece, 3¼" x 1", offering a large range of vision. Can be swung into any position from vertical to horizontal. Sensitive tint plate is mounted in fixed position in eyepiece.

Complete "PRECISION" Photo-elastic Polariscope Laboratory Set-up #13695, including polariscope and loading frame which will accommodate a 8" x 8" sample. Camera has a 4½" aperture. The parallel beam of light is collected by a condenser and converged through a three element lens of the Cooke system, and is projected on to the photographic plate or screen.

The "PRECISION" Polarizer #13696, same as #13695, except aperture 8½". The parallel beam of light is collected by a condenser and converged through a four element lens of the Omnar system. The loading frame used with this size will accommodate an 8" x 8" sample.

NO. 13698

WRITE FOR BULLETIN NO. 1007-H



NO. 13695-6

SEE YOUR LABORATORY SUPPLY DEALER.

PRECISION SCIENTIFIC COMPANY
1736-54 N. Springfield Ave., Chicago 47, U.S.A.
Engineers and Builders of Scientific Apparatus and Production Control Laboratory Equipment for Almost a Quarter Century

Hare and hound together this way—an unusual combination. But that's *nothing* to the unusual combination you get in KYS-ITE: strength coupled with lightness, ruggedness with beauty . . . plus the other "seldom-found-together" properties below. A combination, you'll find, *that no other type of material can offer.*

GREAT STRENGTH WITH LIGHT WEIGHT — Preformed before curing, an even distribution of phenolic resin on interlocking fibres results in great tensile and compressive strength and with an impact strength up to 5 times that of ordinary plastics.

WIDE RANGE OF SHAPES—Complicated pieces with projections and depressions, large or small shapes and sections—all these and more, too, are molded successfully in KYS-ITE.

KYS-ITE CAN "TAKE IT"—Unusually durable and resistant to abrasion, impervious to mild alkali and acid solutions.

INTEGRAL COLOR—KYS-ITE's lustrous finish is highly durable; the color is an integral part of the material itself. A wipe and it's bright!

NON-CONDUCTOR—KYS-ITE's dielectric properties make it invaluable where safety is a factor. Also a non-conductor of heat. Non-resonant and non-reverberating.

EXCUSE IT, PLEASE—But the demand for KYS-ITE has been so extensive we're not in a position to take further specialty orders at this time. The situation, however, is steadily improving, thanks to the lifting of restrictions. Before long we hope to say "Now we're ready" to *anyone* interested in Keyes Molded Products.

KEYES FIBRE COMPANY
420 Lexington Avenue
New York 17, New York
Plant at Waterville, Maine

KEYES
MOLDED PRODUCTS

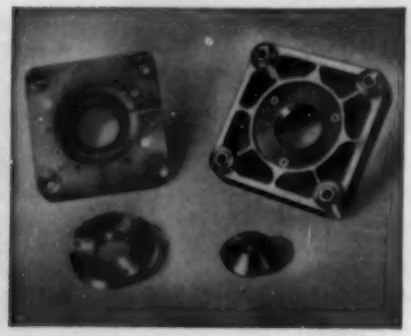
KYS-ITE articles indicating the range of items we mold to specifications and deliver complete, ready for use.

KYS-ITE*

Preformed Plastic Combining Long-Fibred Wood Pulp and Synthetic Resin

*Trademark Reg. U. S. Pat. Off.

POSSIBILITIES IN PLASTICS



Above are examples of engineered plastics, produced by us for military requirements. Their design and production involved molding techniques that can be applied advantageously to many consumer products.

Familiar uses of plastics are being served again. Most significant, in suggesting the larger potential usefulness of molded plastics, will be their successful utilization in applications where other materials have been used by custom or tradition.

During the war years, plastics had to justify selection thru superior performance under field conditions. Molding experience and techniques developed and improved during that period are now available to you thru this organization.

If you seek product betterment, let us help you examine the possibilities in plastics. We have the most improved equipment for injection, transfer and compression molding. Our production is varied, from simple molded parts, produced in volume on high speed injection presses, to complex assemblies, transfer-molded with metal inserts. Our experience and complete facilities—from design to assembly—may benefit you. Get in touch with us. For information on our services, ask for Folder File MP1.

PM
REG. U.S. PAT. OFF.

PLASTIC MANUFACTURERS
INCORPORATED

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Representatives: DETROIT 2—805-06 New Center Bldg. • LOS ANGELES 35—1440 So. Robertson Blvd.
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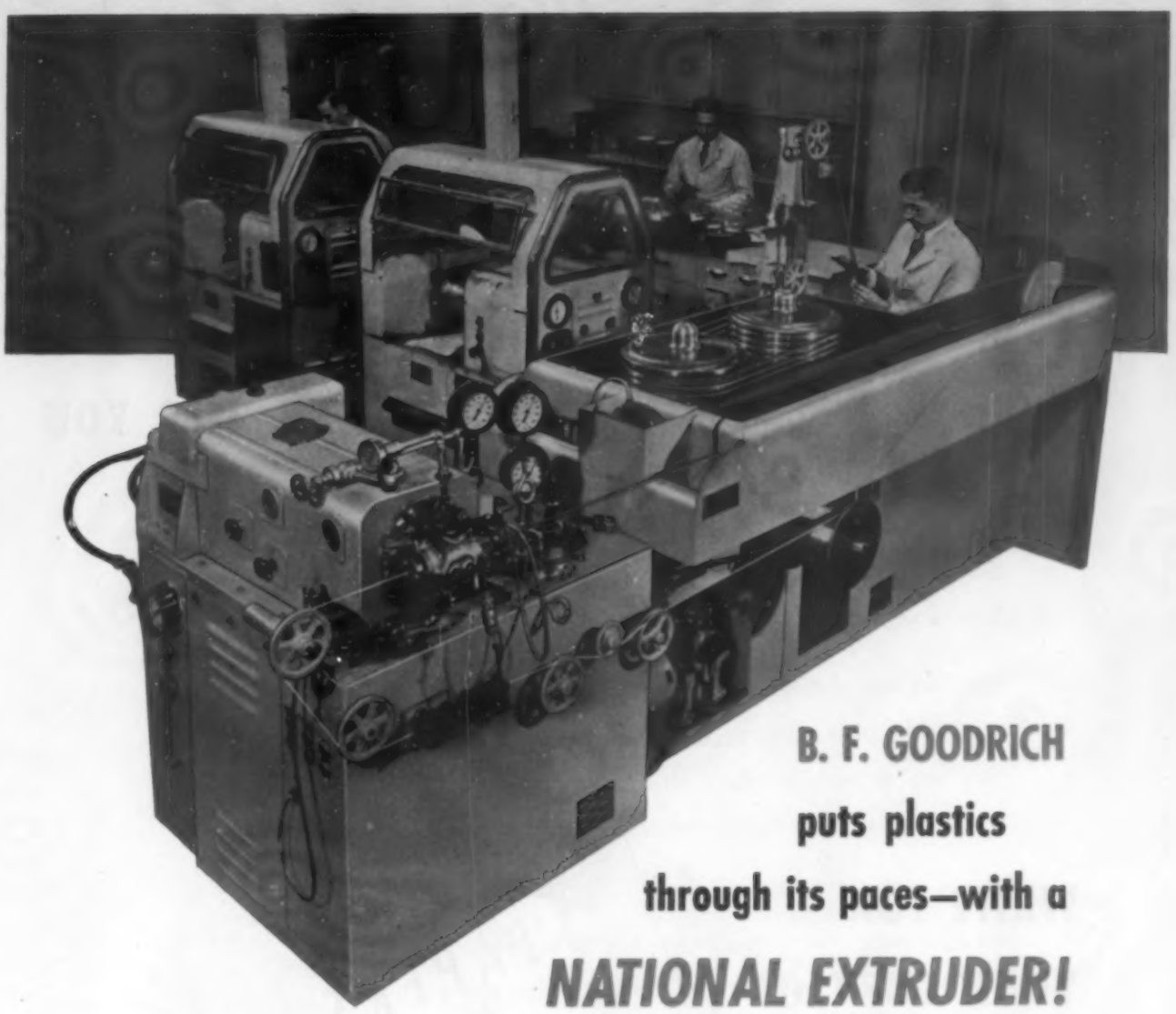

B. F. GOODRICH puts plastics through its paces—with a NATIONAL EXTRUDER!

IN the B. F. Goodrich Chemical Company's laboratory, a National extruder is used to test the extrusion qualities of new compounds under actual operating conditions. The same qualities which make National a natural choice for this purpose can help *you* in *your* plastics production!

Research of this kind demands flexibility. Today there's a run of one type material; tomorrow a different material is extruded in different sizes, at varied temperatures and speeds. National extruders provide this *flexibility, plus* the *exacting accuracy of performance* so essential in both laboratory and production line equipment.

If the plastics products you plan to make require exacting tolerances, continuous, dependable and economical production, or flexibility to process a wide variety of materials, sizes, or shapes, look to National Rubber Machinery Company—the world's largest maker of plastics extrusion equipment. Write today for your copy of our new, complete catalog of extrusion equipment.

NATIONAL RUBBER MACHINERY CO.
General Offices: Akron 11, O.

Plastics
MACHINERY DIVISION

IF PAPERS OF THIS TYPE
HAVE A PLACE
IN YOUR OPERATIONS—
RIEGEL CAN HELP YOU

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RIEGEL PAPER CORP.
342 MADISON AVE.
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RIEGEL-X

x A group of plain and impregnated base papers for high or low pressure laminates x

Thoughts on Plastics...1946

How can plastics help my products? Will the use of plastics enable me to reap the full harvest of all-out peacetime production?

If you are considering a switch to plastics during the year ahead, perplexing thoughts such as these are only natural. Let us set you right on these thoughts. Our analysis of your product will help do it.

When you bring a product to us, you can be sure we will not mold it unless we know the application of plastics will improve your product. Investigate our injection molding and extrusion services today. Our complete imagineering* ability is at your service.

**Imagination and engineering skill.*

Write on your letterhead for the new Injection Molded and Extruded Plastics catalogue. Or, for detailed information about MILLS-PLASTIC* pipe, tubing and fittings, write for circulars containing data and illustrations.

**Trademark Reg.*

ELMER E. MILLS CORPORATION

Molders of Tenite, Lumarith, Plastacele, Fibestos, Lucite, Crystallite, Polystyrene, Styron, Lustron, Loalin, Vinylite, Geon, MILLS-PLASTIC*, Saran and other Thermoplastic Materials

153 WEST HURON STREET, CHICAGO 10, ILLINOIS

MAKE YOUR PLASTIC A CONDUCTOR OF ELECTRICITY

Metaplast

introduces

Silver Conductive

Paints

especially developed for plastics and other non-conductive materials to give a low-resistant conductive coating for electro-plating, electrostatic shielding and other electrical purposes.

Metaplast Silver Conductive Paints can be sprayed, dipped, brushed or printed . . . after sufficient drying time elapses the coating becomes hard and electrically conductive . . . applications are numerous . . . from the printing of electric circuits to electro-plating on non-conductive surfaces.

Metaplast Silver Conductive Paints are for sale by the troy ounce, to all interested firms.

NOTE: The use of Silver Conductive Paints for electroplating plastics is not to be confused with Metaplast's patented process.

Metaplast COMPANY

205 W. 19 St., N. Y. 11, N. Y.

METAPLAST PROCESS PATENTED AND LICENSED

METAL PLATING ON PLASTICS

METAPLAST INTERNATIONAL ENGLAND • FRANCE • CANADA • ARGENTINA • BRAZIL • AUSTRALIA

STYRON

(Dow Polystyrene)

gives you New SCOPE!

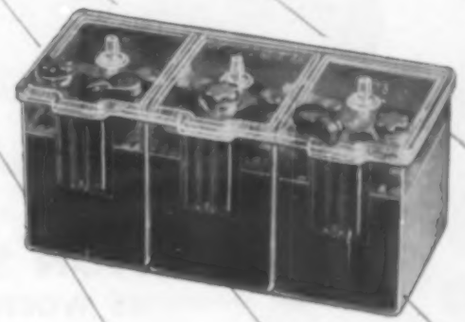
plus sales appeal

Capacity to do a great variety of exacting tasks—and do them better. That's a characteristic of Styron (Dow Polystyrene) with which you've long been familiar.

Now a better Dow Polystyrene—the new Styron 411 Series—makes possible even smoother, and more brilliant surfaces, wider utility, longer wear. And it affords greater ease and economy in manufacturing.

These production advances stem from Styron 411 qualities which permit: Better flow—thinner sections; easier mold release—elimination of mold lubrication; improved machineability—reduced drag on tools, lower frictional heat; improved finishing—easier buffing, with less tendency to scuff or "burn."

Whether you're making tea strainers or batteries, these advantages, with Styron's sparkling colors, acid resistance, low moisture absorption and high dielectric strength, give you new *scope!* And Series 411 Styron is available at the same low prices. It means better products at low cost—plus sales appeal, plus serviceability. Write any Dow sales office for details.



plus serviceability

High accomplishment in plastics will result only when manufacturer, designer, fabricator and raw materials producer put their skills together, working as a team. In the interests of achievement, therefore, Dow urges you to save time and money by putting its experts to work on *your* problem. They'll do their part.

PRESENT AND POTENTIAL USES—Lighting fixtures and displays; insulators; hydrometers; battery cases; funnels; bottles; closures; food handling equipment; pharmaceutical, cosmetic, and jewelry containers; jewelry; advertising items; refrigerator parts; pens, pencils; chemical apparatus; lenses; decorative objects and trim.

PROPERTIES AND ADVANTAGES—Beautiful, clear, translucent; "pipes" light through rod around corners, etc.; resistant to acids and many alkalies; stable at low temperatures; excellent electrical properties; broad color range; low specific gravity providing more moldings per pound; low water absorption.

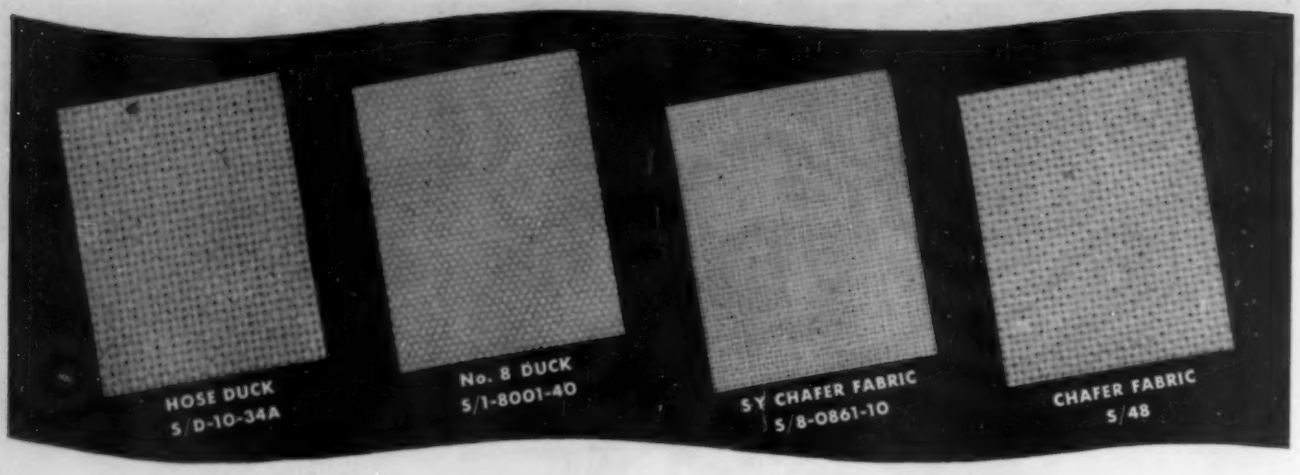
THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

New York • Boston • Philadelphia • Washington • Cleveland • Detroit • Chicago
St. Louis • Houston • San Francisco • Los Angeles • Seattle

DOW

PLASTICS

STYRON • STYRALOY • ETHOCEL
ETHOCEL SHEETING • SARAN • SARAN FILM



Fabrics for Plastics

As representatives of a number of textile mills specializing in industrial fabrics we are in a position to offer plastics manufacturers an unusually wide range of fabrics.

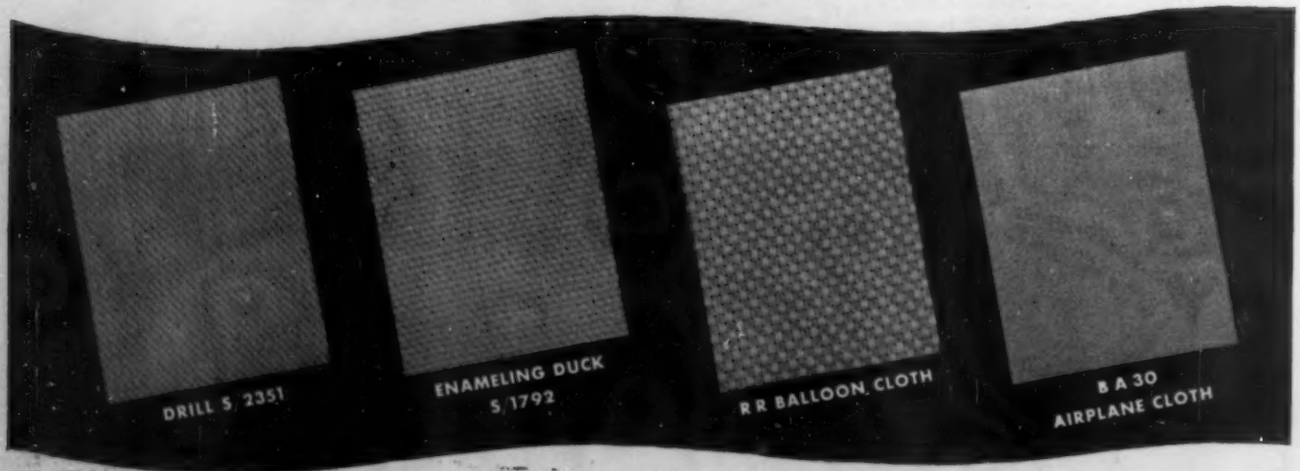
In addition, we maintain the finest textile research laboratories and are constantly working on the development of new fabrics for special purposes.

Our textile experts are available to consult with you on the selection of the most suitable fabrics for your products or processes.

Send for Sample Book

These fabric samples for the Plastic Industry represent 12 types of fabric — selected from several thousand fabric constructions made in the mills we represent. In addition to standard constructions, we develop fabrics to specifications.

WELLINGTON SEARS COMPANY, SALES AGENTS
65 WORTH STREET • NEW YORK 13, N. Y.



THE MOST IMPORTANT QUESTION IN BUYING *Molded Plastics*

Are you planning a molded plastic part for your product? If you are, please bear this fact in mind . . . *the most important matter you have to consider is your choice of custom molder.*

Because . . . he will be wholly responsible for a vital part of your product . . . for solving engineering problems . . . designing and building the molds . . . running the job . . . finishing each piece . . . and feeding it into your production lines as your schedule demands. The very success of your product may hinge upon his engineering and production ability.

Therefore, before you make your decision you'll find it well worth while to get the answers to these questions:

1. Has he a long record of successful and dependable service in the field?
2. Does he provide a complete service, assuming undivided responsibility for designing, mold-making, molding and finishing?
3. Are these services within his own organization—coordinated under a single engineering and operating group?
4. Can he provide the method best suited to your job, whether it be compression or injection molding?
5. Has he the correct size and type of press to handle your job most efficiently and economically?
6. Does he have a reputation for doing even the toughest jobs well?

If he can answer all of these questions in the affirmative, you're safe. Give him the job.

If you'd like *our* answers to those six questions, you'll find them in this new book, and it's brim full of valuable information . . . facts and figures important to any buyer of molded plastics . . . fully illustrated with photographs, charts, and drawings. Write for your free copy today . . . on your firm letterhead, please.

CHICAGO MOLDED PRODUCTS CORPORATION

1046 N. Kolmar Ave. Chicago 51, Illinois

Branch offices in principal industrial centers

COMPRESSION AND INJECTION MOLDING OF ALL PLASTIC MATERIALS

Our Moldings are Wearing Diamonds

We have always told you that if you staid with Boonton, you would be wearing diamonds and now our prophecy is coming true!

No, we are not going into the jewelry business. But we are using diamonds—industrial diamonds—in many of our finishing operations. We are not the first in the plastics industry to use diamonds, but we have done a great deal of research and development work in conjunction with a manufacturer of diamond tools on the finishing of molded parts.

The net result, as far as our customers are concerned, is the ability to adhere to more precise tolerances and to perform the over-all finishing job more efficiently and more economically.

In our advertising, we have tried to stay away from the horn-blowing approach but this new development in plastics manufacturing has so much to offer that we couldn't resist one factual message.

We can tell you and show you a lot of other things about plastics manufacture, too. We will be glad to if you will let us.

Our plant—all of it—is open for your inspection at any time.

No diamonds with this book but a free copy of "A Ready Reference For Plastics"—introduction to plastics—if you request it on your letterhead.

BOONTON MOLDING COMPANY

MOLDERS OF PLASTICS · PHENOLICS · UREAS · THERMO-PLASTICS

BOONTON · NEW JERSEY · Tel. Boonton 8-2020

NEW YORK OFFICE

Chanin Bldg., 122 East 42nd Street, New York 17, N. Y.; MUrray Hill 6-8540

Accurate Long Wearing Gages

ARE MADE FROM

GRAPH-MO STEEL

Few products demand the skill and accuracy that is required in the manufacture of gages. The steel from which they are made must be of equally high calibre.

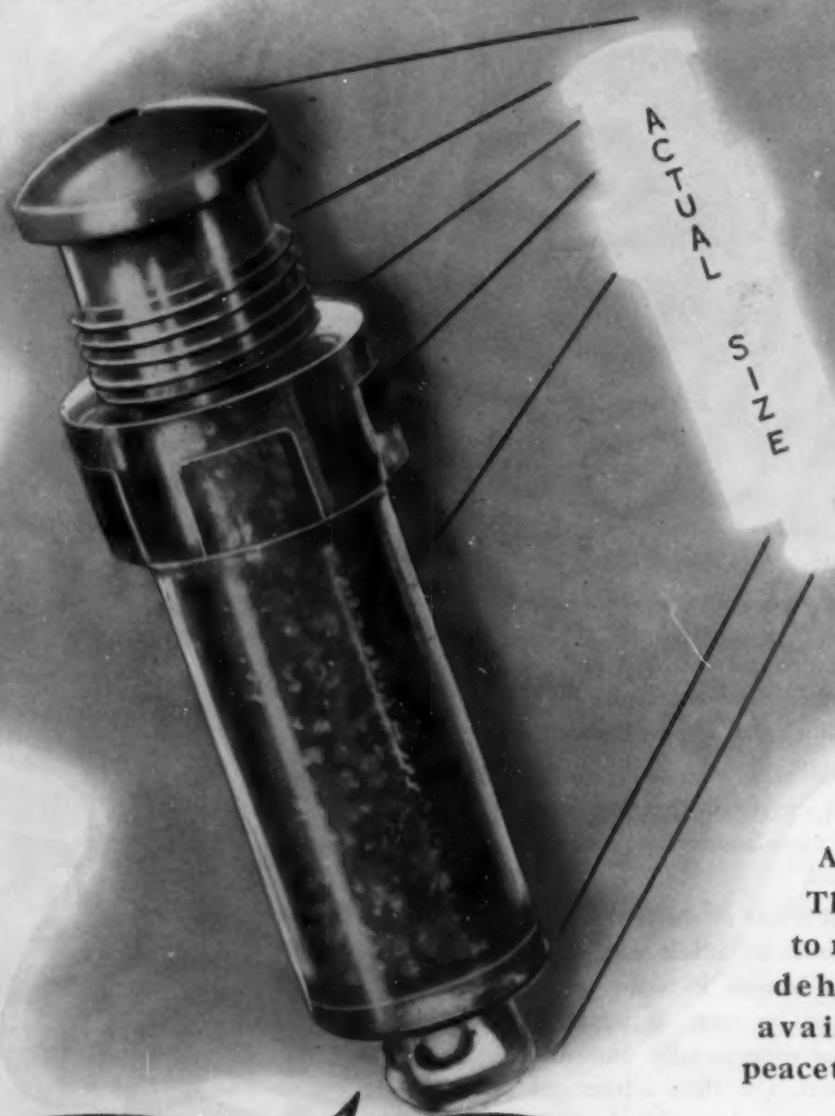
Recognizing this fact is the reason that so many of the best known gage manufacturers are making gages of Graph-Mo Steel.

This oil hardening steel is one of the five famous Timken Graphitic Steels. It offers makers of gages many advantages because it resists growth, offers stubborn resistance to wear, is remarkably free machining and has exceptionally uniform response to heat treatment. Use these advantages to speed production of gages that will have long, accurate life. Steel and Tube Division, The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN
TRADE MARK REG. U. S. PAT. OFF.
GRAPHITIC STEELS

A request written on your firm's letterhead will bring a 48 page booklet that tells how, when and where to use the five famous Timken Graphitic Steels.

WE HAVE THE INGENUITY TO WORK OUT *Problems*



THIS IS
A WAR PRODUCT...
The skill necessary to make this aircraft dehydrator is now available for your peacetime production.

INJECTION MOLDING
MINCOR
YOUR PLASTICS DEPARTMENT

MAKE US YOUR *Plastics* DEPARTMENT

MINNESOTA
PLASTIC CORP.

366 WACOUTA STREET
ST. PAUL 1, MINNESOTA

Manufacturers of quality products, with complete facilities for injection molding — Research, engineering, product and model design, tool and die making — press capacity 2 to 16 ounces — printing, machining, fabricating and assembling departments.

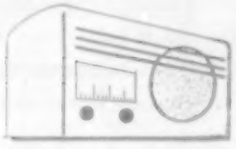
CASE FOR THE CELLULOSICS...

answer to housing problems for cameras or clocks, radios or rings

Do your housings need close dimensions, unusual toughness and light weight, brilliant color, lasting luster? Does high-speed injection molding and elimination of material waste suggest manufacturing savings? Then specify the cellulosics, and get all these advantages and many more!

These are some of the reasons why Elmer E. Mills Corporation, Chicago, Ill., uses cellulose acetate for molding not only camera cases like the one above, but mass-production housings of every type—from clock cases to lipstick containers.

Now is the time to check into the cellulosics—most useful and economical of all plastics.



Rapid production and assembly, toughness, for portable and table radios

Grease resistance, permanent color, for kitchen clocks

Durable and eye-appealing display-gift cases for jewelry

HERCULES

CELLULOSE ACETATE
CELLULOSE NITRATE
ETHYL CELLULOSE

For general-purpose production plastics

Hercules does not make plastics or molding powder, but supplies the high-quality cellulose derivatives from which they are made. For data, please write

HERCULES POWDER COMPANY INCORPORATED 916 Market Street, Wilmington 99, Delaware

CP-68

UNERRING hands need this *Floating* lamp

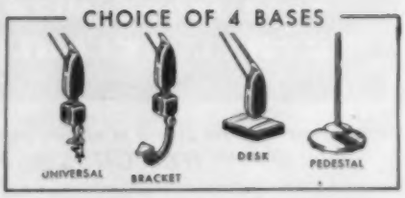
Precision engineering and manufacture call for unerring hands. But hands, unfortunately, can do well only what the eyes see clearly.

Aided by the *flexible,* intense *localized* lighting provided by Dazor *Floating* Lamps—instantly adaptable to the needs of each worker, each job—your employees will see the fine details of work easily, comfortably, accurately. Their hands will work faster with fewer mistakes and minimum fatigue.

And a touch of the hand does it—*floats* the Dazor Lamp to any desired position, where, without adjustment or locking, it *stays put* until moved to a new position. This exclusive feature results from a patented enclosed balancing mechanism.

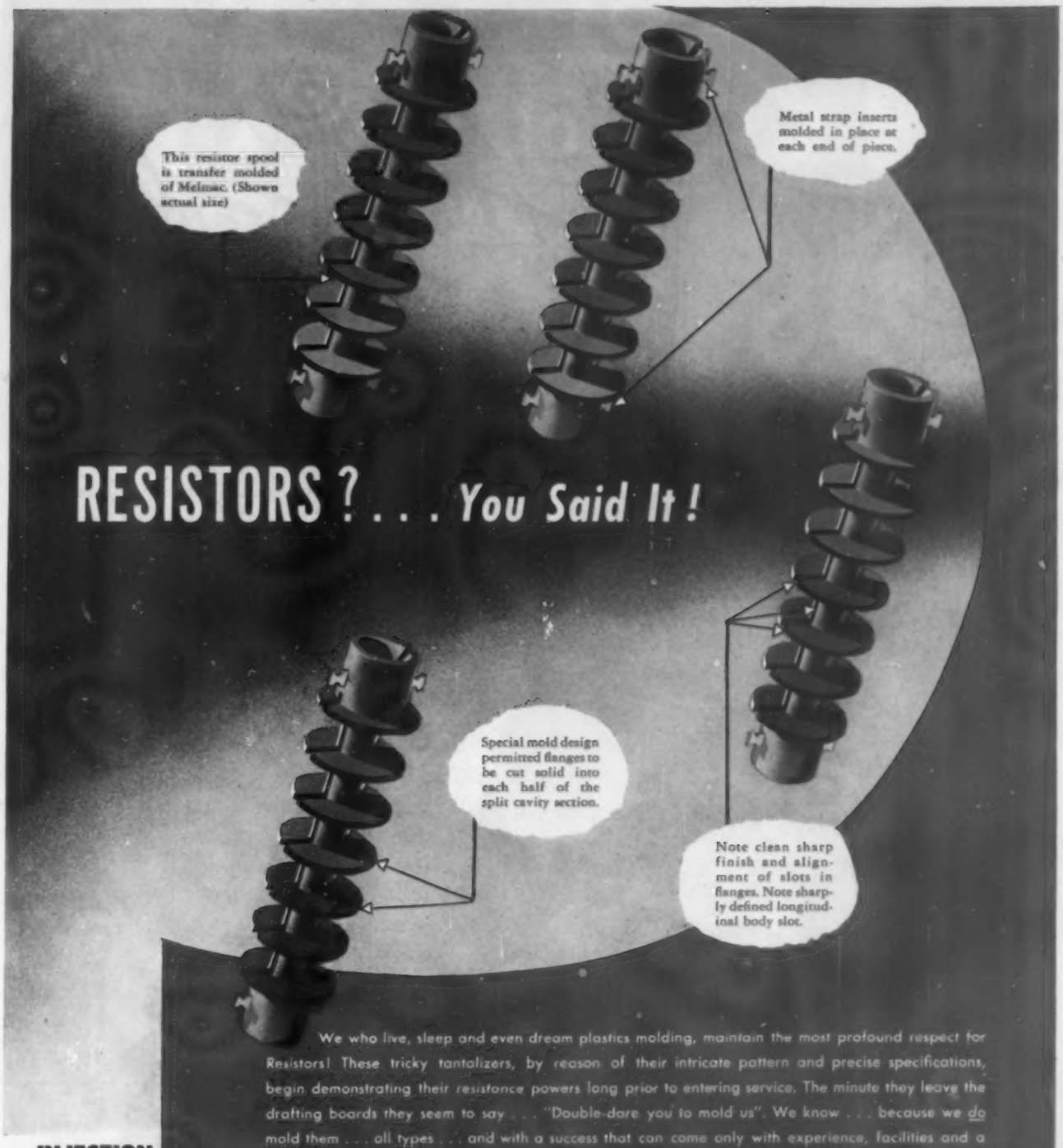
Near you is a Dazor-appointed distributor who is qualified to give sound, practical advice and application assistance. Phone him for detailed information and a demonstration of the Dazor *Floating* Lamp under actual working conditions. His name, if unknown to you, can be secured by writing to the Dazor Manufacturing Co., 4483 Duncan Ave., St. Louis 10, Mo. *In Canada* address all inquiries to the Amalgamated Electric Corporation Limited, Toronto 6, Ontario.

PHONE THE DAZOR-APPOINTED DISTRIBUTOR NEAR YOU *TODAY*



DAZOR *Floating* LAMPS

FLUORESCENT and INCANDESCENT


This resistor spool is transfer molded of Melmac. (Shown actual size)
Metal strap inserts molded in place at each end of piece.
RESISTORS ? . . . You Said It !
Special mold design permitted flanges to be cut solid into each half of the split cavity section.
Note clean sharp finish and alignment of slots in flanges. Note sharply defined longitudinal body slot.

We who live, sleep and even dream plastics molding, maintain the most profound respect for Resistors! These tricky tantalizers, by reason of their intricate pattern and precise specifications, begin demonstrating their *resistance* powers long prior to entering service. The minute they leave the drafting boards they seem to say . . . "Double-dare you to mold us". We know . . . because we do mold them . . . all types . . . and with a success that can come only with experience, facilities and a thorough understanding.

For the Resistor Spool, shown here, Consolidated also engineered and constructed, in its own plant, the special four-cavity, semi-automatic type of mold required for the part's quantity production. Although this achievement illustrates Consolidated quality at work for others, we invite the opportunity to apply its plastics know-how to your own product. Inquiries invited!

INJECTION molding
TRANSFER molding
COMPRESSION molding

CMP "YOUR BLUEPRINT IN PLASTIC"

Consolidated MOLDED PRODUCTS *Corporation*
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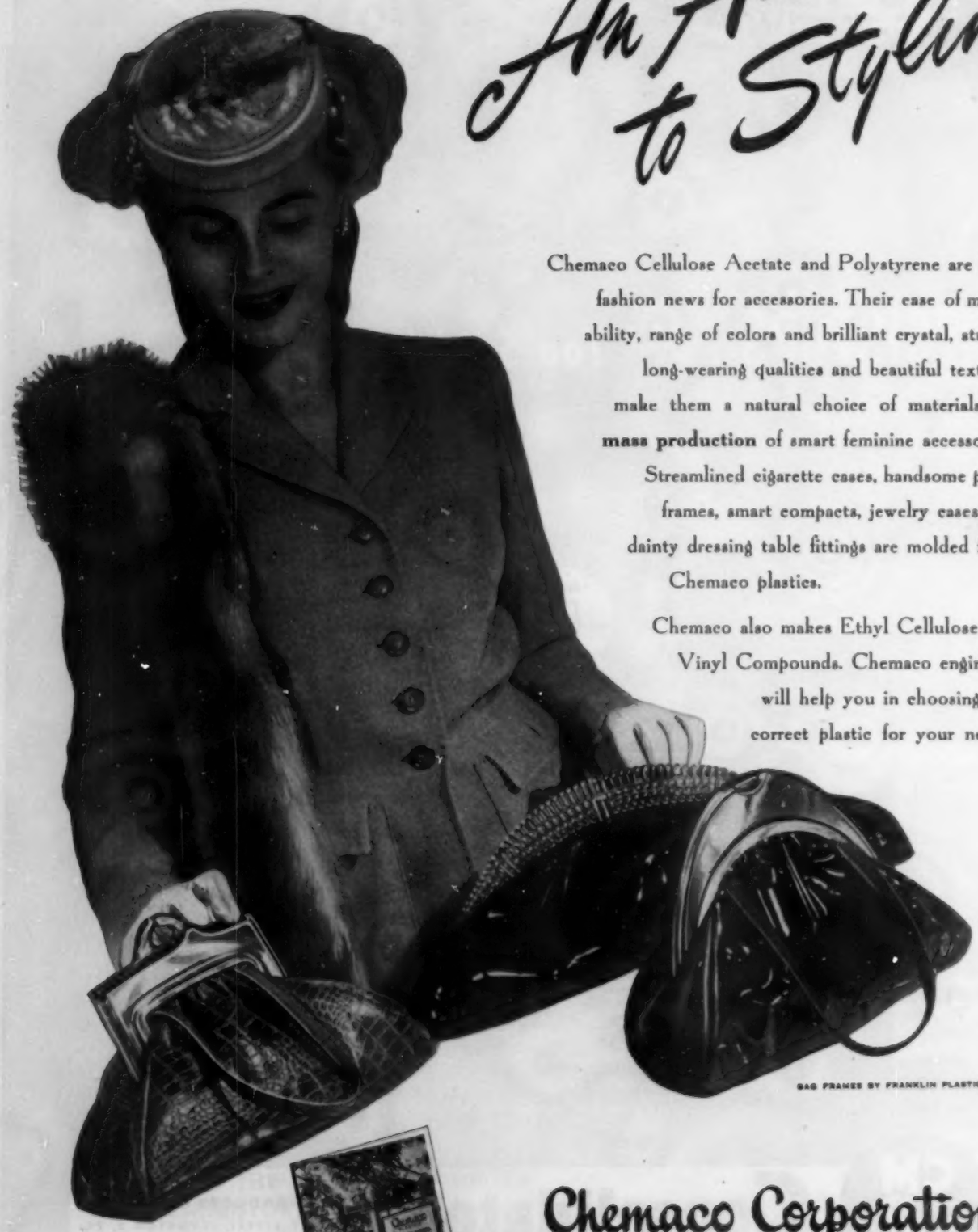
Branches: NEW YORK • CHICAGO • DETROIT BRIDGEPORT • CLEVELAND

An Accessory to Styling



BAG FRAMES BY FRANKLIN PLASTICS

Chemaco Cellulose Acetate and Polystyrene are high fashion news for accessories. Their ease of moldability, range of colors and brilliant crystal, sturdy, long-wearing qualities and beautiful textures make them a natural choice of materials for **mass production** of smart feminine accessories. Streamlined cigarette cases, handsome purse frames, smart compacts, jewelry cases and dainty dressing table fittings are molded from Chemaco plastics.

Chemaco also makes Ethyl Cellulose and Vinyl Compounds. Chemaco engineers will help you in choosing the correct plastic for your needs.

Send for the new Chemaco Catalogue. Write Dept. G.

Chemaco Corporation

(A subsidiary of Manufacturers Chemical Corporation)

Berkeley Heights, N. J.

Branch Office—Cleveland, O.

PROGRESS

Tomorrow's Achievements Cannot Be Measured Today

IN PLASTICS

MOLDING PRESSES

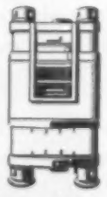
It has been said that recent developments in plastics "telescoped fifty years of progress into the past five years." We *question* that statement.

Certainly, the half-decade just passed witnessed greater progress than the fifty years preceding. But the *rate* of progress is never static. No one can schedule *ingenuity,* in plastics or in anything else.

LABORATORY PRESSES

Progress Moves Ever Faster

The whole idea of plastics is only a little older than our own Elmes organization, and there are *many* parallels. Like plastics, Elmes' evolution was gradual—a step-by-step development. Vague objectives were crystallized into definite purposes. Problems were approached from many angles. Expanding applications opened *vast* new fields for service. And, like plastics too, Elmes' progress accelerated year by year to a *new high* during the war period.



HOBBING PRESSES

This We Know

Could it be possible that either plastics or Elmes progressed fifty years, or even *twenty-five,* since 1940? We think not. Progress moves too swiftly for prediction. But whatever its tempo in plastics, you'll find Elmes equipment ready with the new-that's-good, combined with the *tried-and-proved.*

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HIGH PRESSURE PUMPS

ELMES HYDRAULIC EQUIPMENT

ELMES ENGINEERING WORKS OF AMERICAN STEEL FOUNDRIES • 225 N. Morgan St., Chicago 7, Ill.
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AN INVITATION

how to put 10 plastics experts on your problems...

without putting them on your payroll...

Whether you're a molder, fabricator, manufacturer or end-user of plastics, you're invited to use this Monsanto Plastics Technical Council.

Set up just a few months ago, it has already given help and advice to hundreds . . . expert, balanced counsel on the widest variety of plastics problems: materials, methods, costs, design, service factors. (Note a few typical examples at right.)

Ten Heads Are Better Than One

Your problem will receive the benefit of the best thinking of ten picked plastics experts. Each one is a specialist in a major, different phase of plastics practice. Together they represent over 100 years of experience in this young industry.

How to Proceed

All you need to do is to write a letter outlining in full your particular question. The council will review your inquiry thoroughly at its next weekly meeting, then give you promptly a written, comprehensive report . . . something tangible to work with. To avoid delay you might wish to send in advance for our special questionnaire form.

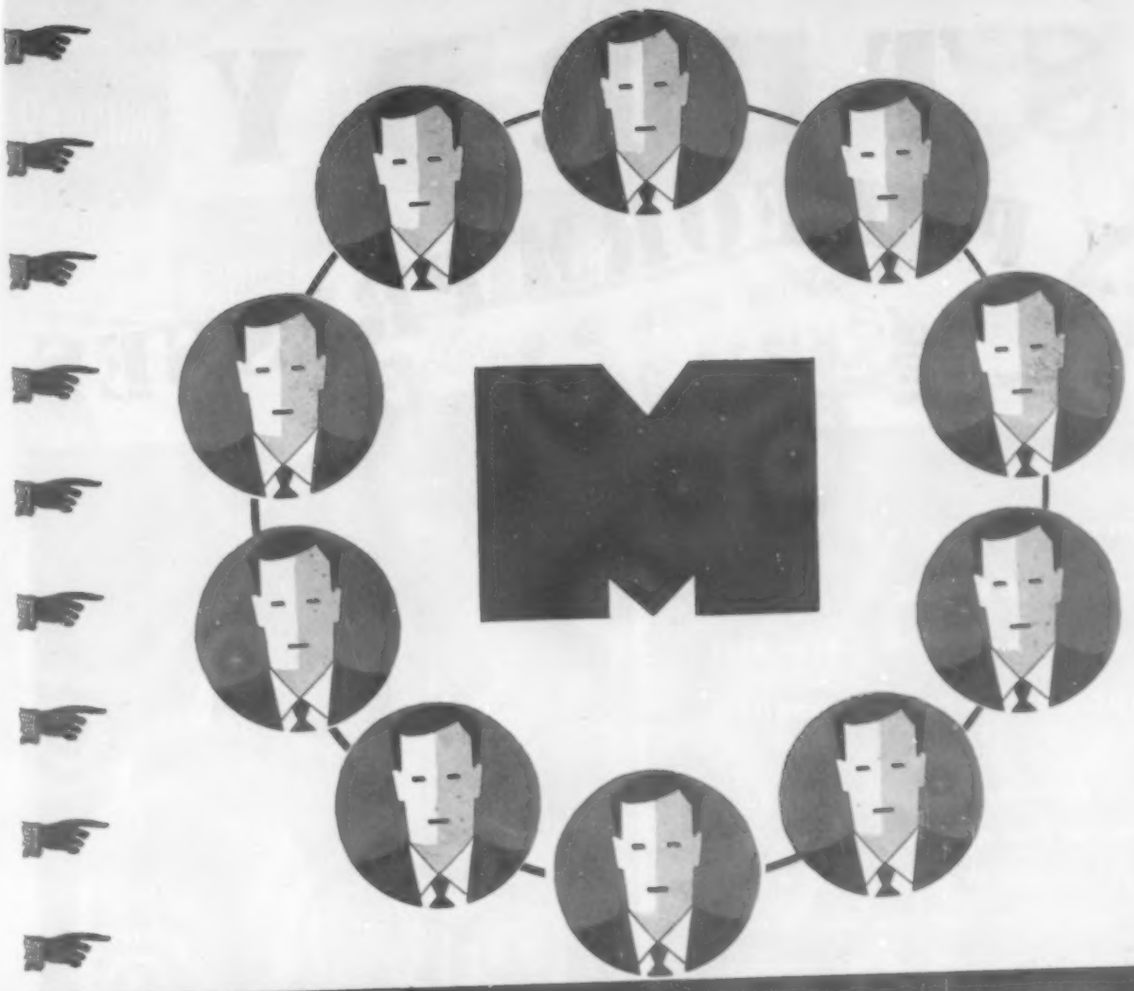
Address all questions about the Council . . . or requests for technical data on any one of Monsanto's versatile family of plastics, to: MONSANTO CHEMICAL COMPANY, Plastics Division, Springfield 2, Massachusetts.

*Reg. U. S. Pat. Off.

MONSANTO PLASTICS

SERVING INDUSTRY . . . WHICH SERVES MANKIND

The broad and versatile family of Monsanto Plastics includes: Lustron* polystyrenes • Cerex* heat resistant thermoplastics Vinyl acetals • Nitron* cellulose nitrates • Fibestos* cellulose acetates • Thalid* for impression molding • Resinox* phenolics • Resimene* melamines Forms in which they are supplied include: Sheets • Rods Tubes • Molding Compounds Industrial Resins • Coating Compounds • Vuepak* rigid, transparent packaging materials.



here are the kind of problems handled by the council:

...although overall quantity will be quite large, we wish to be able to change styling and exterior design The bowl itself is 28 inches in diameter, and should diffuse the light well with high light transmission.

Our work is the sand casting of light metals. In some cases it is necessary to seal porosity. Can you recommend...

...We are looking for a coated cloth to use in our line of welders' visors and face shields. The cloth should be flexible but able to deflect sputterings of hot metal and should not...

A paperboard for use in cartons and packaging boxes with greater resistance to water and to scuffing would enable us to improve the serviceability of our products. We now have the following treating equipment available...

In our newly designed hypodermic syringe, a transparent cylinder 7¼" by ½" i.d. is specified. The part must be sterilized in boiling water and totally unaffected by...

In redesigning our portable lineman's scaffold, we wonder if the steel tubing now used can be replaced economically with a plastic. The loads are calculated as...

A new theatre here will use wall panelling throughout the lobby and lounges. Something that is colorful washable and distinctive in appearance is needed in panels up to eight feet in height.

We believe that a lightweight tiling in good colors would have a big place in the export market. Can you suggest a plastic which we could...

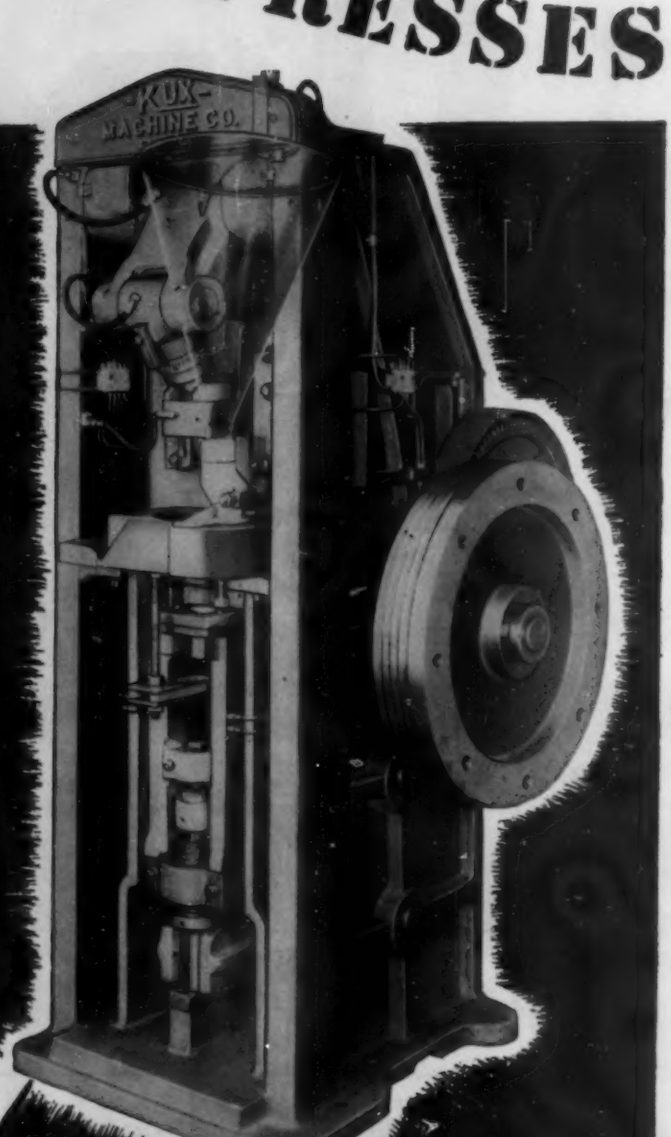
STURDY

KUX PREFORM PRESSES

The new massive Model 65 produces preforms 3" diameter, has a 3" die fill and applies 75 tons pressure

This rugged preform press with its heavy-duty, one-piece cast steel main frame will produce odd shapes as well as round preforms. The pressure applied by both top and bottom punches results in more solid, dense preforms, which have less tendency to crumble or break during handling. This new Model 65 press is built to safely withstand high pressures of up to 75 tons at top production efficiency.

Choice of a complete size range of machines in both single punch models and multiple punch rotaries is also available.



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SYNTHETIC RESINS

Varcum Resins have won many friends during the war through their outstanding qualities and the ease with which the organization adapted them to new applications.

With the facilities of our new laboratory we are now adapting these quality resins to meet specific requirements. We offer this service in:

1–Special resins for all types of molded, impregnated or extruded brake linings and friction materials.

2–Resins to replace animal glue as binders for abrasive discs, belts or other contemplated abrasive products.

3–Binders, for cork composition sheets, which are non-toxic and odorless.

4–Resins for protective coatings which will eliminate the use of high percentages of china, wood and oil.

5–Impregnating or coating resins and varnishes for paper, cloth and wood.

6–Special thermo-setting resins as highly resistant coatings for aluminum, magnesium and other metal products.

7–Resins for all types of molding compounds, i.e. compounds containing woodflour, mica, graphite, asbestos, etc.

Varcum laboratories are available to assist you in your development work on new products or the adaptation of present products to new requirements. Consult Varcum on any new ideas you have which might require the use of phenolic resins.

VARCUM

CHEMICAL CORPORATION

NIAGARA FALLS, NEW YORK

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Through evolutionary development, features are incorporated in Royle continuous extruding machines to secure successful results with the growing number of extrudable compounds. The laboratory technician is assured that the results obtained with a Royle #1 (2″ bore) will be obtainable with the larger Royle models.

The inherent efficiency of Royle continuous extruding machines is further enhanced by the

EXTRUDER TEMPERATURE CONTROL UNIT

- Wide temperature range available
- Sustains high or low temperatures
- Supplies or removes heat from extruder as required
- Multiple circuits can be accommodated
- Hand lever selection of predetermined extruding temperatures
- Available in two sizes
- Compact

Whether you plan experimental or product extruding send for bulletins #443 and #444. Let them suggest to you how Royle continuous extruding machines and the Royle Extruder Temperature Control Unit can meet your specific problem.

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For your tough plastics problems

IN COMPRESSION, INJECTION, TRANSFER

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PLASTICS CATALOG

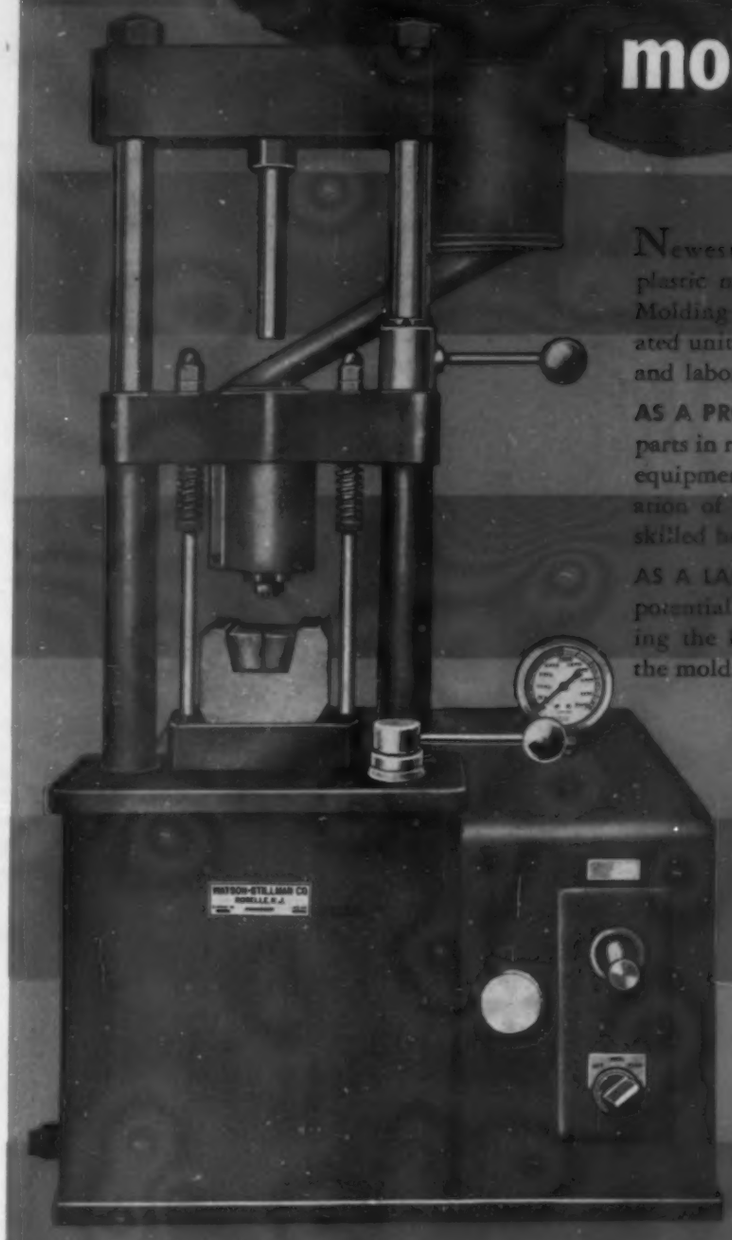
Fabricating Polystyrene—1944 PLASTICS CATALOG

Write to

INDUSTRIAL MAGAZINE SERVICE, Inc.

122 East 42nd St., New York 17, N. Y.

W-S one-ounce injection molding press



Newest addition to the Watson-Stillman line of plastic molding presses is this One-Ounce Injection Molding Machine — a self-contained, manually operated unit that is well adapted to short-run production and laboratory use.

AS A PRODUCTION UNIT — In the molding of small parts in runs too short to warrant setting up automatic equipment. The simplicity of set-up and ease of operation of this new machine permit the use of semi-skilled help.

AS A LABORATORY UNIT — For testing the molding potentiality of single-cavity dies, preparatory to making the large multiple-cavity dies, and for checking the molding characteristics of the material to be used.

Write today for Bulletin No. 623-A describing this machine. No obligation — of course. Watson-Stillman Co., Roselle, New Jersey.

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HYDRAULIC MACHINERY DIVISION

FACTORY AND MAIN OFFICE
ROSELLE, NEW JERSEY

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The "Paperologists" of The Mills of Mosinee have helped many product engineers and manufacturers put winning advantages into their products . . . such as controlled maximum-minimum *p*H — uniform specified density — high tensile strength — definite dielectric strength — moisture repellency—and other technical characteristics to meet various market demands.

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Equipped with broad experience, extensive laboratory facilities, and outstanding paper-engineering leadership, Mosinee "Paperologists" are qualified and ready to cooperate with your organization . . . whenever you say. A conference will not obligate you.

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OUT GOES SPOILAGE!

Hamstrung by work-spoiling driver skids while he used slotted screws, a certain radio cabinet manufacturer made a complete switch-over to Phillips Recessed Head Screws. Result: production shot up like a rocket!

DOWN GO COSTS!

With this upward swing in production, there was a consequent *downward* swing in costs. A downswing that was helped along plenty by the fact that Phillips Screws drive up to 50 percent faster!

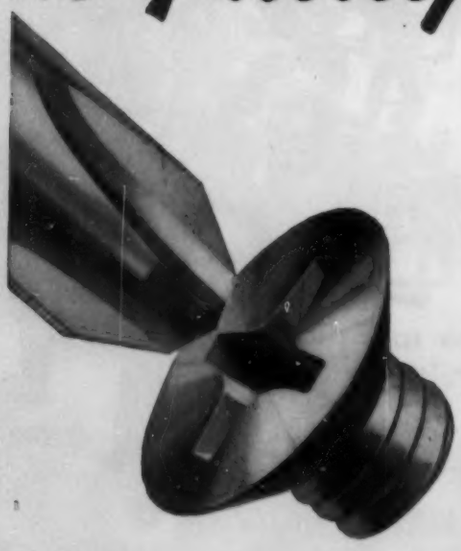
UP GOES STRENGTH!

On production . . . on costs . . . yes, also on design, . . . use of Phillips Screws makes a big difference. Engineered for heaviest driving pressures, they help designers plan exceptional strength and rigidity into products!

AWAY GOES SALES RESISTANCE!

Saleswise, too, use of Phillips Screws pays off. They not only add to a product's strength, smartness, and general good looks. They also banish burrs that snag clothes and sidetrack sales!

It's Phillips — the engineered recess!



In the Phillips Recess, mechanical principles are so correctly applied that every angle, plane, and dimension contributes fully to screw-driving efficiency.

. . . It's the exact pitch of the angles that eliminates driver skids.

. . . It's the engineered design of the 16 planes that makes it easy to apply full turning power – without reaming.

. . . It's the "just-right" depth of recess that enables Phillips Screw Heads to take heaviest driving pressures.

With such precise engineering, is it any wonder that Phillips Screws speed driving as much as 50% – cut costs correspondingly?

To give workers a chance to do their best, give them faster, easier-driving Phillips Recessed Head Screws. Plan Phillips Screws into your product now.

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WOOD SCREWS • MACHINE SCREWS • SELF-TAPPING SCREWS • STOVE BOLTS

Made in all sizes, types and head styles

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Wolverine Bolt Co., Detroit, Mich.

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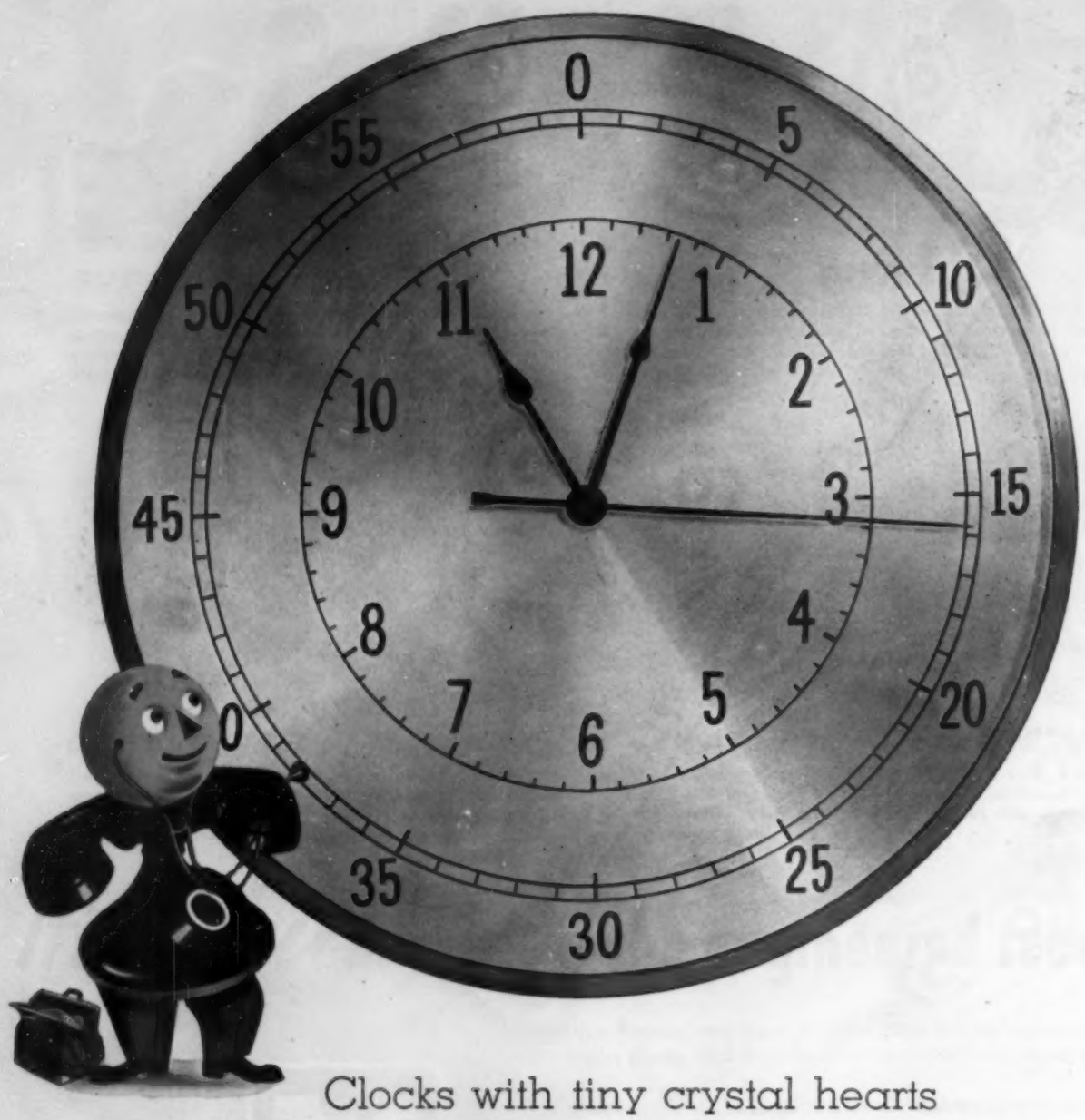
THE MICHIGAN

MOLDED PLASTICS, INC. An intimate ability to handle orders . . . a personalized service that focuses complete attention on *every* order . . . these, linked to the astounding range of versatility that has produced miracles in plastics . . . make *Michigan Molded* a name synonymous with *plastic-excellence*. Small but mighty is Michigan Molded; the very modesty of its size and over a quarter century of experience are contributing factors in those intimate details producing real satisfaction . . . real and lasting results! We're busy now, but never too busy to consider your plastic needs . . . Sales and Engineering Offices are located in: Buffalo · Chicago · Cleveland · Dayton · Detroit · Kansas City Minneapolis · Moline · Philadelphia · St. Louis. General Offices and Plants: Dexter, Michigan.



Clocks with tiny crystal hearts that beat 100,000 times a second

CRYSTAL HEARTS beat time in Bell Telephone Laboratories, and serve as standards in its electronics research. Four crystal clocks, without pendulums or escapements, throb their successive cycles without varying by as much as a second a year.

Precise time measurements may seem a far cry from Bell System telephone research, but time is a measure of frequency, and frequency is the foundation of modern communication, whether by land lines, cable, or radio.

These clocks are electronic devices developed by Bell Laboratories, and refined over years of research. Their energy is supplied through vacuum tubes, but the accurate timing, the controlling heart of the clock, is provided by a quartz crystal plate about the size of a postage stamp.

These crystal plates vibrate 100,000 times a second, but their contraction and expansion is submicroscopically small—less than a hundred-thousandth of an inch. They are in sealed boxes to avoid any variation in atmospheric pressure, and their temperatures are controlled to a limit as small as a hundredth of a degree.

Bell Laboratories was one of the first to explore the possibilities of quartz in electrical communication, and its researches over many years enabled it to meet the need for precise crystals when war came. The same character of research is helping to bring ever better and more economical telephone service to the American people.

BELL TELEPHONE LABORATORIES *Exploring and inventing, devising and perfecting for continued improvements and economies in telephone service.*

Just what is the GORDON PLASTICATOR ?

Imagine two temperature-controlled cylinders or chambers, placed end to end, in which revolves a single spiral-threaded rotor. At one end there is an extruding head, provided with circuits for application of heating and cooling; at the other, an adjustable speed motor driving the rotor through reduction gears at the optimum speed for most efficient working of each plastic.

THAT IS THE GORDON PLASTICATOR.

F-B PLASTICS MACHINERY

- Banbury Internal Mixers
- Roll Mills
- Converting, Mixing and Sheeting Rolls
- Calenders
- Plasticators
- Extruding Machines
- Hydraulic Presses
- Hydraulic Accumulators
- Sheet Cutters or Planers

Powders or granules fed into the hopper of the machine are densified and fused as they are pushed forward by a powerful forcing thread. They are then acted upon by the plasticating section of the rotor, and all the ingredients are blended to make a homogeneous whole. For some plastics a further mixing and blending is required and this is accomplished either by a "torpedo" or a fluted cone and head. The design depends upon the types of plastics to be handled.

Passage through the machine will neither contaminate the product nor spoil delicate colors. All parts of the Plasticator which are in contact with the ingredients are made of materials extremely resistant to corrosion and abrasion.

Write to us for details of how this unique machine can serve you. Our engineers will be glad to work with you on your processing problems.

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Somewhere in the large family of Plyophen phenolic resins and varnishes you'll find one exactly suited to your production operation. And when you do you'll have a *find* indeed because Plyophens are outstanding in the very things you need to spur production of quality laminates. Plyophens are exceptional in curing speed. Surprisingly low pressures are required. And their bonding properties are all you could require. Write direct to the sales department for a complete list of versatile, useful Plyophens.

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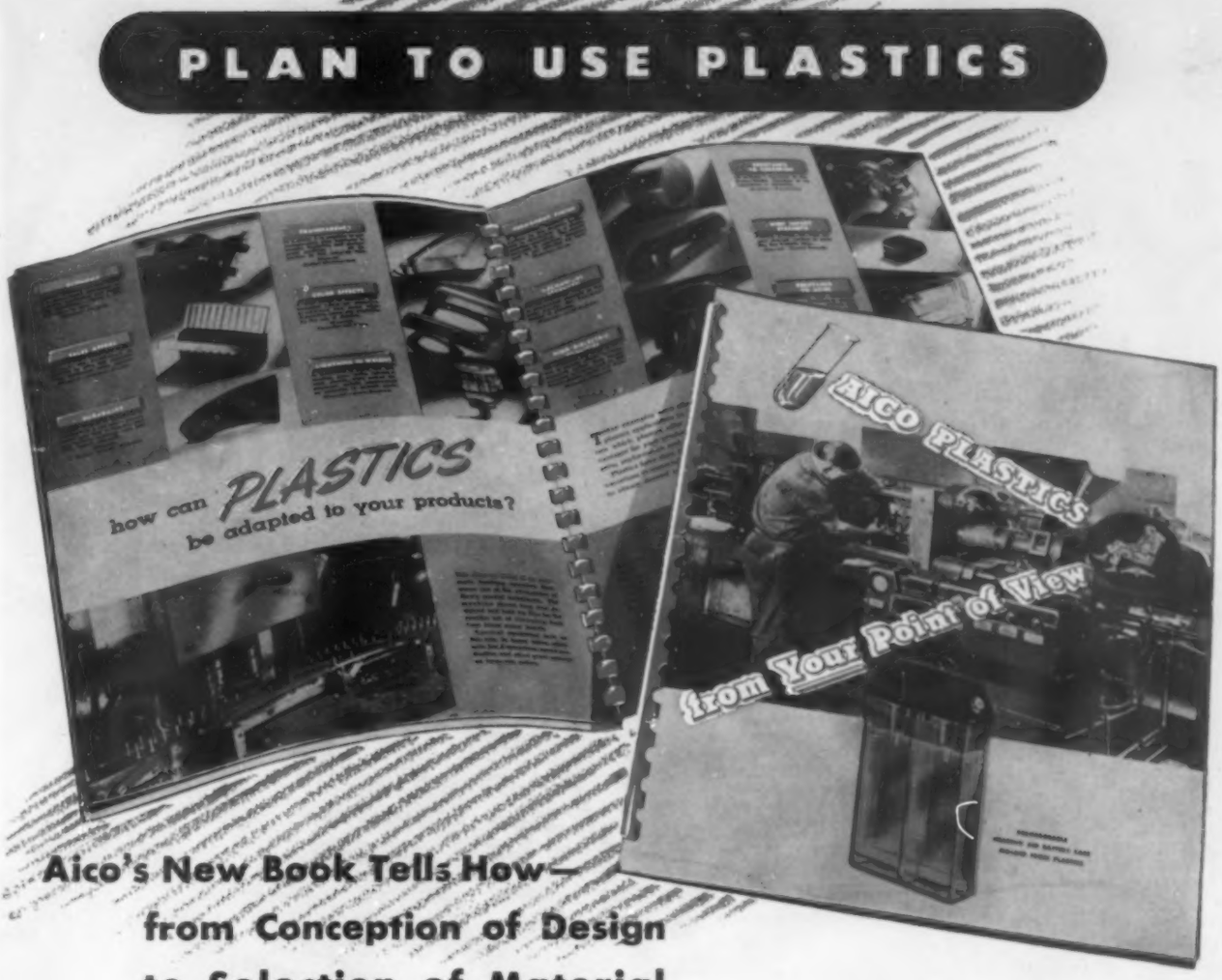

Aico's New Book Tells How—
from Conception of Design to Selection of Material

"*Aico Plastics from Your Point of View*" has been written so the layman can obtain a better understanding of the possibilities . . . and limitations . . . of plastics. In nontechnical terms it briefly describes the development of plastics, the adaption of many familiar products to plastics; describes the various molding methods, outlines the common pitfalls of plastics design and has a comprehensive chart showing the *comparative* physical properties of the most commonly used materials.

It doesn't attempt to make a plastics engineer out of every reader—but it does tell how to take the first steps toward a successful plastics application. It provides a basis for intelligent plastics discussion. It will stimulate creative thinking of product designers. Plastics engineers will find it useful, too—because much of the unlimited material about plastics has been boiled down to its basic essentials and presented in a way that is easy to refer to and use.

STOCK MOLD CATALOG INSERT

There is a 52-page catalog of Aico stock molds bound inside the back cover. Hundreds of stock parts . . . stove handles, radio knobs and many others . . . are clearly illustrated by photographs and dimensional drawings. The handy index has a complete description of each mold and provides quick reference to the illustrations.

Put your products in a better competitive position—*plan to use plastics.* A request on your letterhead will bring your copy of this useful book . . . without obligation. AMERICAN INSULATOR CORPORATION, NEW FREEDOM, PA.

Aico

PRECISION MOLDING

30th Year

design and engineer your plastic problem with

INDUSTRIAL'S
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Every step in the development and production of your plastic product is guided by Industrial's twenty-five years of experience in compression molding. Our designers' and engineers' knowledge of materials and processes can solve problems in design, fit, finish, density, color and type of material. Our die makers are skilled technicians in creating precision single or multiple cavity molds. Our molders produce high volume within extremely close tolerances. In the finishing stage each product receives rigid inspection and analysis assuring you of uniform quality. At each step of plastic production Industrial offers an important service. Call on their technical staff of experts today with your problem.

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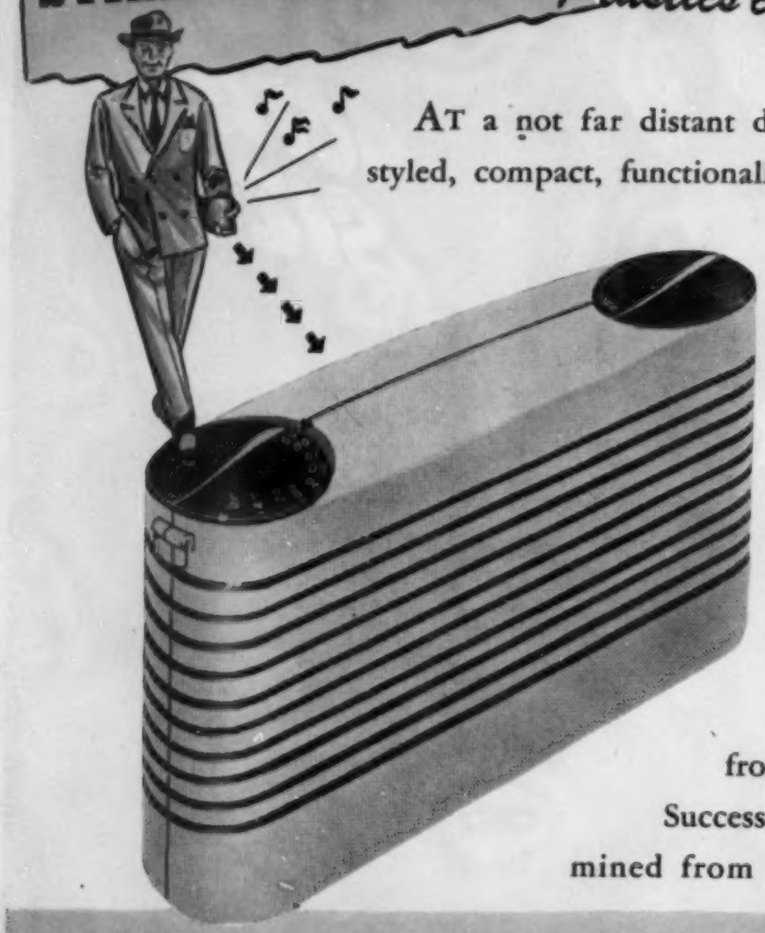

AT a not far distant day, you'll be carrying a smartly styled, compact, functionally designed Portable Radio like this to the beach, lake, mountain resort—anywhere you may wish to take the world's news, music, or entertainment.

Each part of the precision designed radio unit was carefully planned and model tested before engineering the mould from which it was originally cast. Successful performance was predetermined from the very moment of inception.

So it is that in the preliminary designing phases of your own plastic products, Eclipse engineers, designers, and stylists can give you aid of inestimatable value. For this specialized organization is geared to bring into effective play a knowledge and understanding of your problems that results in definite time and money savings for you. For every Eclipse design, as well as plastic material, is combined so as to fully meet the test of useful, profitable public acceptance.

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"Shirt sleeve session" of Eclipse executives on customers' problems.

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Plastic Division of General American Transportation Corp.

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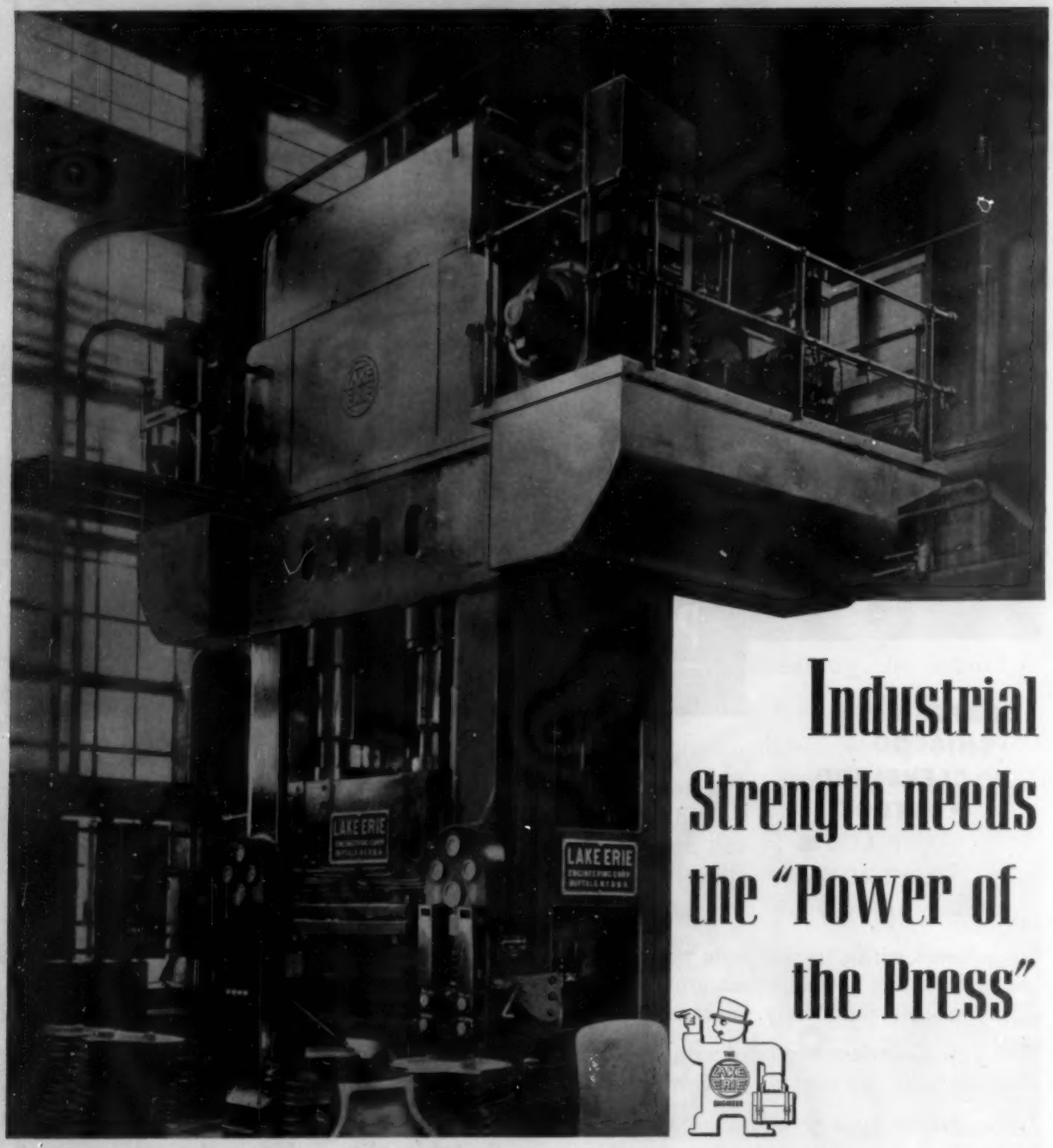

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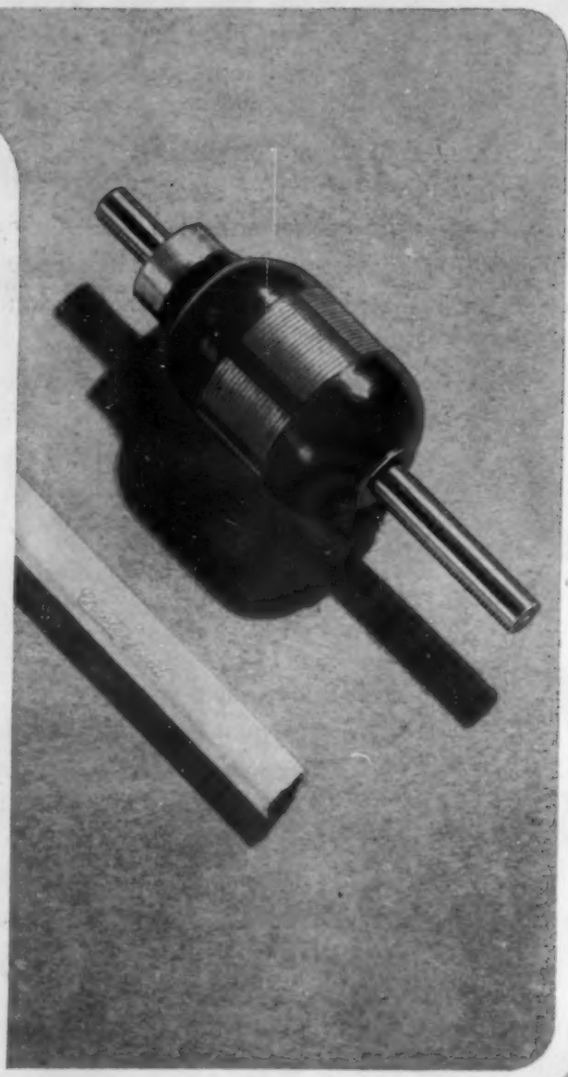
A licensed molder near your own plant can offer you the advantages of Transfer molding when you specify plastics "packaging" of small motors and other electrical apparatus, to obtain good appearance in addition to first class insulation.

The fractional horsepower motor armature shown at right was totally enclosed with phenolic compound by the Transfer molding process and is a good example of how this process can produce a nicely finished product with full protection to the electrical circuit.

The precise ruggedness required by wartime applications proved the superiority of Transfer molding, in which the compound is fully plasticized in a chamber connected with the closed mold—then flows into the mold without disturbing or distorting delicate inserts or windings. The "eye appeal" demands of peacetime competitive markets are now being similarly served.

To learn in detail the many advantages of Transfer molding, write for the literature listed below. To put these advantages to work, call in your nearest licensed Transfer molder. A list of such molders will be sent on request.



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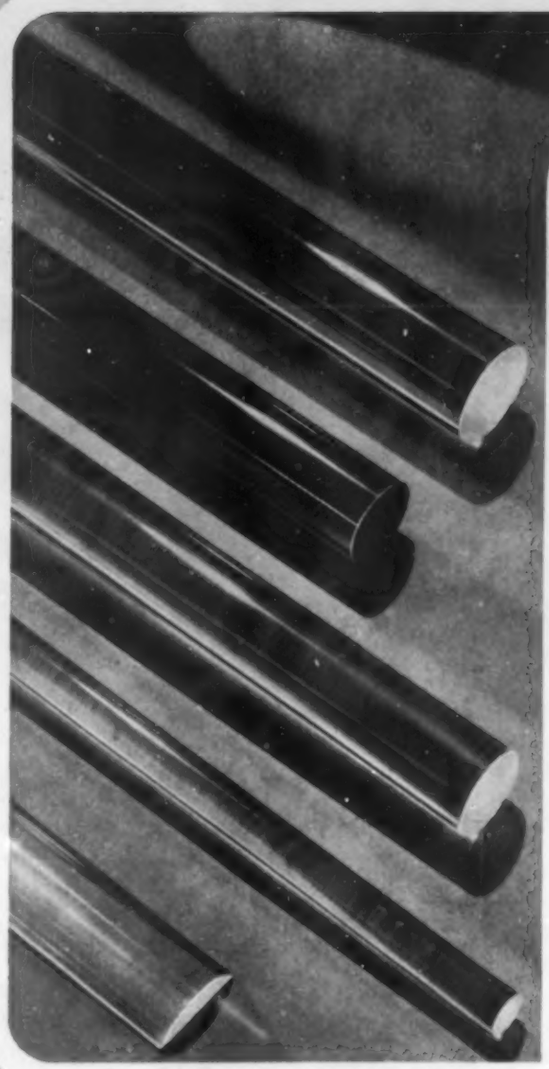
LITERATURE IS AVAILABLE AS FOLLOWS:

Reprints of technical papers by Shaw engineers are available upon request, as are the following bulletins:

Two bulletins on "Why Transfer Molding Is Economical". Bulletins on "Why Transfer Molding Gives Fine Inserts", "Why Transfer Molding Improves Appearance", "Why Transfer Molding Permits Better Holes", "Why Transfer Molding Permits Variable Walls", "Why Transfer Molding Gives Uniform Strength", "Why Transfer Molding Gives Longer Runs", and "Why Transfer Molding Produces Better Irons".

Whatever your plastics problem, you can get the help you need from either Shaw or the Plax Corporation, 133 Walnut Street, Hartford 5, Conn. For the literature listed above, and for a list of licensed Transfer molders . . . write Shaw.

POLISHED POLYSTYRENE ROD AVAILABLE NOW



Plax polystyrene rod is now available in a new form: with a highly polished surface lustre. Thus designers may now readily work with crystal-clear rods of this unique material.

In this form, Plax polystyrene rod requires very little fabricating and it is easily polished after fabrication. A cutting-down wheel, using a compound held by a non-petroleum grease, will remove any surface imperfections caused by machining — and the final high lustre is restored by a soft cotton buff, free of compound.

The availability of crystal-clear polystyrene rod will suggest many new uses for this versatile material, which is light, hard, inexpensive, and easily fabricated. A few of the applications which immediately come to mind are push bars and racks, display and decorative fixtures, edge lighting effects, novelties, etc.

Plax polished polystyrene rod is available in standard 4' lengths in all diameters up to 2". Special lengths and colors are available on minimum order. Samples are available for testing purposes.

POLYSTYRENE LITERATURE AVAILABLE:

Bulletins on how to machine, polish and cement polystyrene; on what to tell machinists about polystyrene; and on how to use coolants with polystyrene are available on your request.

While Plax has been the leader in development of uses for polystyrene, we also offer several other plastic materials in unique forms and shapes.

In fact, between the resources of Plax and the Shaw Insulator Company, Irvington 11, N. J., you can obtain help and counsel in the use of most plastic materials and processes. For the literature mentioned above . . . write Plax.

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The answer is the best material for your part or product. We have the facilities to help you pick the right material or develop a specific rubber or plastic compound for your job

Here's a case where rubber worked better

IN the problem of selecting the right material for an electrical connection coupler with a difficult range of specifications, painstaking research on both rubber and plastics finally resulted in the development of a special compound which met all requirements. At first, a combination of metal and phenolic parts to meet the electrical and physical specifications was tried out, but, under test, it was found that the coupler shorted when it was subjected to water or damp weather. Various rubber compounds were tested but none of the compounds available at the time had the range of physical characteristics necessary to meet all field and connection conditions. Our laboratory then developed a special rubber compound with the specific compressibility for a tight seal and other physical characteristics for a varied field service in addition to the specifications of high dielectric strength, very low permanent set and low power factor.

There are many other cases where synthetic or natural rubber works better than any of the newer plastics. Nothing has yet been developed to beat the over-all properties of hard rubber in water meter applications, for instance, particularly dimensional stability and high resistance to moisture and solvents. And in addition to its slow water absorption rate and high softening point, hard rubber has the advantage of easy machinability. The same reasons hold true for its choice in many applications in other fields where it withstands submersion and exposure to gases much better than newer plastic materials.

Rubber, one of the oldest plastics, has, with the development of synthetic formulas, become one of the newest. With the return of adequate quantities of natural rubber to the market, the position for the synthetic changes from a wartime substitute to one having advantageous qualities of its own. Its ability when properly compounded to withstand extreme cold without stiffening, and its exceptional resistance to certain solvents, make it the best material for products exposed to gasoline, oils and acids.

Special soft rubber compounds available or developed

We have developed compounds to ASM and ASTM specifications and it may be that just the material you need is among the many highly specialized compounds we have available. If you have a problem involving the use of soft rubber or want to replace an ordinary compound with a specific compound for the job, we are in a position to help you.

We have large scale transfer, extrusion and compression manufacturing facilities, precision fabrication to commercial or special tolerances in rods, tubing sheets, or molded rubber products.

IN SOME CASES HARD RUBBER WORKS BETTER . . .

	Thermal Setting Molding Compositions							Thermal Plastic Molding Compositions				
	Phenol-Formaldehyde	Phenol-Furfural	Urea-Formaldehyde	Melamine-Formaldehyde	Hard Rubber			Methyl-Methacrylate	Polystyrene	Ethyl-Cellulose	Cellulose-Acetate	Cellulose-Acetate Butyrate
	Woodflour Filler	Woodflour Filler	Alpha Cellulose Filler	Alpha Cellulose Filler	High Grade (Ebonite)	Medium Grade	Low Grade	Molding Powder	Molding Powder	Molding Powder	Molding Powder	Molding Powder
Specific Gravity	1.32-1.47	1.30-1.40	1.45-1.50	1.45-1.55	1.17-1.20	1.20-1.30	1.30 up	1.16-1.20	1.054-1.070	1.07-1.18	1.27-1.37	1.10-1.24
Tensile Strength, lbs. per sq. in.	6,500-9,500	5,000-8,500	8,000-13,000	8,000-13,000	7,000-9,500	3,500-7,000	1,500-3,500	4,000-10,000	5,000-9,000	2,000-9,000	1,500-8,200	1,600-6,700
Elongation, %	0.4-0.8	—	—	—	2.5-6.0	2.5-3.5	1.0-2.5	1-12	2-5	5-100	7-80	25-95
Compression Strength, lbs. per sq. in.	25,000-36,000	28,000-34,000	25,000-30,000	27,000-37,000	12,000	9,000	6,000-9,000	10,000-15,000	11,500-15,000	8,000-20,000	5,000-30,000	7,500-22,000
Flexural Strength, lbs. per sq. in.	9,000-12,000	8,000-15,000	10,000-16,000	10,000-16,000	15,000	10,000	7,500	10,000-19,000	6,000-10,000	3,000-12,000	2,000-12,000	1,600-12,000
Impact Strength, ft. lbs. per in. ½ x ½ in. notched bar, Izod Test	0.24-0.40	0.36-0.40	0.28-0.32	0.24-0.35	0.30-0.55	0.30-0.70	0.10-0.25	0.2-0.4	0.3-0.5	0.8-11.5	0.4-6.2	0.6-9.0
Hardness, Rockwell	M110-M120	M65-M75	M110-M130	—	M80-M105	M85-M100	M85-M100	M60-M112	M75-M90	R20-R110	R60-R120	R60-R120
Distortion under Heat °F (Softening Point)	260-300	270-290	260-280	385	160-180	160-180	160-180	163-190	170-175	120-300	100-215	100-180
Dielectric Strength, short-time volts per mil, ⅛ in. thickness	230-375	325-530	300-400	300-400	470	460-470	250-460	300	500-700	400-600	250-365	250-400
Power Factor, 60 cycles	0.03-0.20	0.04-0.28	0.029-0.032	0.043-0.045	004	004-.006	006	0.05-0.07	0.0001-0.0003	0.005-0.015	0.01-0.06	0.01-0.04
Water Absorption, 24 hrs., percent	0.4-1.0	0.2-0.6	0.5-0.7	0.3-0.6	0.02	0.02	0.02 Variable	0.3-0.5	0.00-0.03	1.0-2.0	2.0-6.0	1.0-2.4
Burning Rate	Very low	Very low	Very low	Nil	Slow	Slow	Slow	Slow	Slow	Slow	Slow	Slow
Effect of Sunlight	Light shades discolor	Light shades discolor	None	Slight color change	Discolors	Discolors	Discolors	Very slight	Yellows slightly	Slight	Slight	Slight
Effect of Weak Acids	None to slight depending on acid			None	None	None	None	Practically all	None	Slight	Slight	Slight
Effect of Strong Acids	Decomposed by oxidizing acids. Slight effect by reducing and organic acids.		Decomposed or surface-attacked	Decomposes	Decomposed by oxidizing acids Little affected by others			Affected by oxidizing acids.		Decomposes	Decomposes	Decomposes
Effect of Weak Alkalies	Slight to marked depending on alkalinity			None	None	None	None	Practically all	None	None	Slight	Slight
Effect of Strong Alkalies	Decomposes	Decomposes	Decomposes	Attacked	None	None	None	Practically all	None	Slight	Decomposes	Decomposes
Effect of Organic Solvents	None on blood-proof materials			None	Insoluble	Insoluble	Insoluble	Soluble	Soluble	Soluble	Soluble	Soluble
Effect of Metal Inserts	Inert	Inert	Inert	Inert	Inert	Inert	Inert	Inert	Inert	Inert	Inert	Inert
Machining Qualities	Fair-Good	Fair-Good	Fair	Fair	Excellent	Very Good	Good	Excellent	Fair-Good	Good	Good	Good
Clarity	Opaque	Opaque	Translucent-Opaque	Translucent	Opaque	Opaque	Opaque	Transparent 90-92% Light Transmission	Transparent 88-92% Light Transmission	Transparent, Translucent, Opaque		
Color Possibilities	Limited	Limited	Unlimited—Pastel Shades	Unlimited	Limited	Limited	Limited	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited
Molding Qualities	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
Mold Shrinkage, in. per in.	0.006-0.010	0.005-0.009	0.005-0.011	0.008-0.015	S.C. .016-.018 D.C. .030-.032	S.C. .016-.018 D.C. .030-.032	S.C. .014-.016 D.C. .028-.030	0.003-0.006	0.002-0.008	0.001-0.011	0.002-0.005	0.003-0.005

The advantages of selecting a molder with facilities for both rubber and plastics.

The problem of material selection for a part or product is not always easy in these days of rapid advance. New and better plastics are constantly being developed as are new compounds in synthetic and natural rubber. The best material for your part or product depends on the job it has to do from appearance to performance.

Just as it made sense for us with 60 years of molding experience to go in for the newer plastics, it also made sense to continue our research and fabrication in rubber. We therefore believe we are in a good position to help you find the latest and best material or, should your product require it, develop a special plastic or rubber compound for the job.

We have completely equipped and staffed chemical and physical laboratories for all the necessary research and testing to match the wide range of plastic and rubber materials against the specifications dictated by the mechanical, chemical, optical, electrical and fabrication requirements your product may have to meet.

Our experienced staff of engineers and technicians have helped in the development of many plastic and rubber products for various industrial and commercial fields.

Complete service

Not only will our engineering staff help you find the latest and best plastic or rubber material for your part or product but it is very likely that our research assistance and facilities for efficient, large scale production will fill your needs at reasonable cost. If you would like to have an engineer call to discuss your needs, please write Dept. C.

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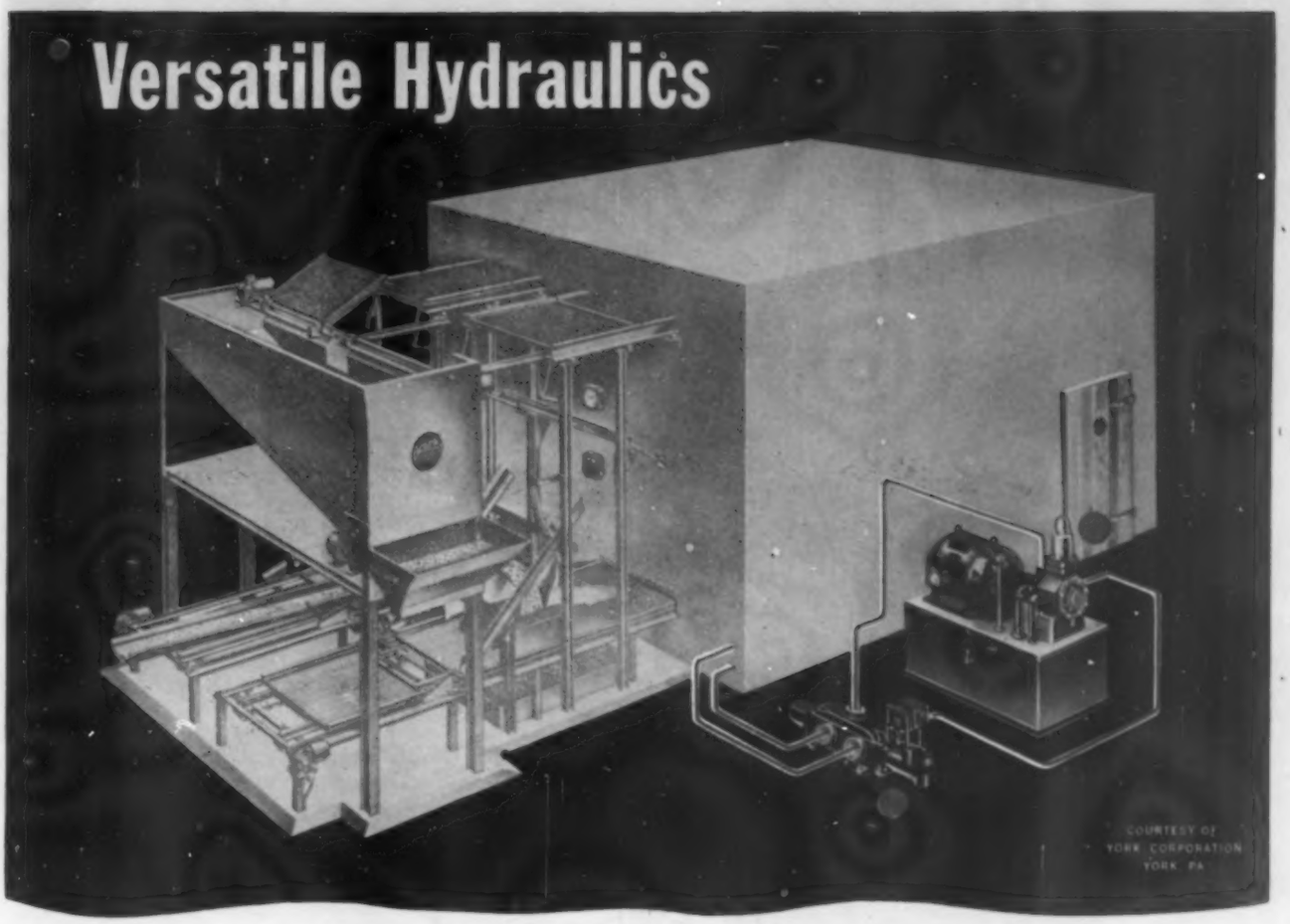
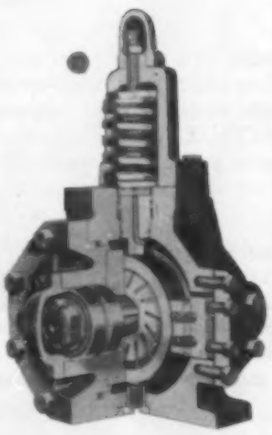


WITH RACINE *Variable Volume* OIL HYDRAULIC PUMPS



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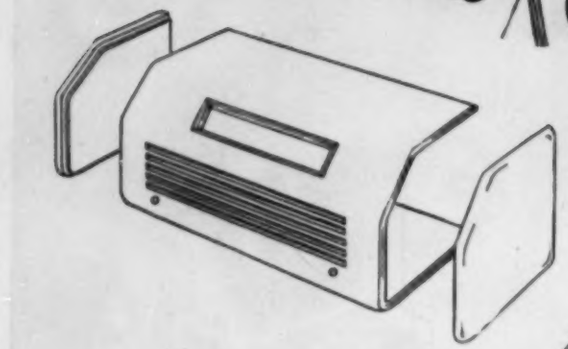

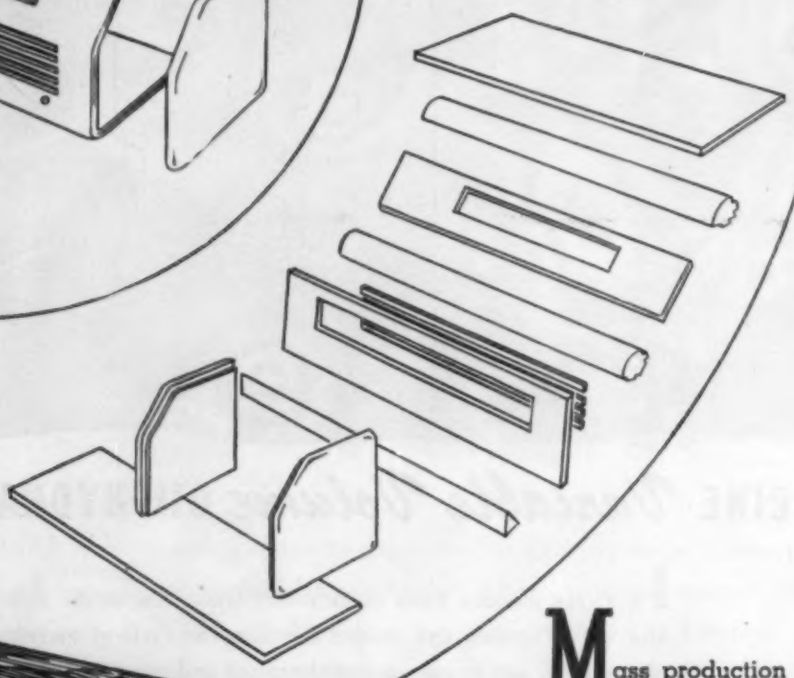

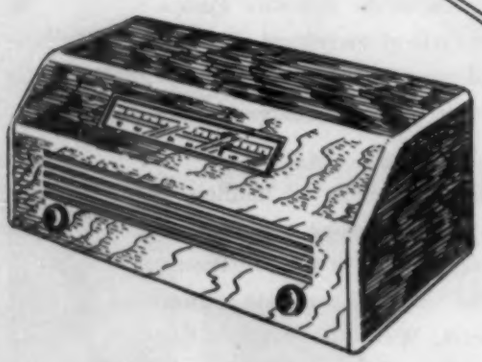

Mass production of fine wood assemblies is simpler, quicker and less expensive with veneers and plywood molded and bonded with PENACOLITE G-1215. Just one example of this modern adhesive's wonder working is in the production of the richly styled and finished radio cabinet illustrated here.

Note the six operations eliminated from the assembly. Note the curved shape of the casing which, when molded with PENACOLITE G-1215, will never warp or delaminate. And note, too, the surface—a paper-thin veneer which permanently endows the entire cabinet with the quality of any fine wood you may select.

For advice and assistance in applying PENACOLITE G-1215 to your production and to your product, consult PENACOLITE Division.

Write PENACOLITE DIVISION

PENNSYLVANIA COAL PRODUCTS COMPANY
PETROLIA, PENNSYLVANIA

• Distributed in Canada by **CANADIAN INDUSTRIES, LIMITED**, Montreal, Canada

For *ALL* the Profit-Making Advantages of Electronic Preheating

2.5 kw
Model DH

SPECIFY AIRTRONICS*

COMPACTNESS

Never before has so much power and utility been packed into so small a space as in the *advanced* line of AIRTRONICS Preheaters.. For example, the 2.5 kw Model DH, with *all* the AIRTRONICS production-speeding features of control and operation, measures only 18" x 22" x 36"—small enough to locate easily wherever it may be needed.

SIMPLE OPERATION

All AIRTRONICS Preheaters have been designed for maximum simplicity of operation. Power output and preheating time are *automatically* controlled. To operate, the molder simply places the charge between the sturdy self-positioning electrodes, closes the hood and presses the proper "start" button.

EASY ADJUSTMENT

Dual power and time controls are mounted on a pivoting panel recessed in the cabinet front. Tilted out, the panel is fully accessible for set-up adjustments. Tilted in and locked, the set-up controls are *completely out of the way*, preventing unauthorized changes.

VERSATILITY

AIRTRONICS Dual Load Selection, Automatic Power Regulation and Wide Range Load Accommodation make possible efficient handling of a greater variety of preheating jobs than ever before. In particular, the dual set-up controls permit running two entirely different loads, alternately, or in any sequence.

These are but a few of the many improvements that have been incorporated into AIRTRONICS Preheaters to provide the plastics molder with *all* the production advantages of electronic preheating. Other improvements include Automatic Excitation Regulation, which maintains maximum preheater efficiency; and powerful Vacuum Cooling of the high frequency components, which assures trouble-free performance under the most rigorous operating schedules.

Inquire at any AIRTRONICS office for full details about the complete series of AIRTRONICS Preheaters, including models from 2 to 10 kw.

*REG. U. S. PAT. OFF.

Airtronics MANUFACTURING CO.

Chicago, 407 S. Dearborn, Zone 5
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Here's a BALDWIN PRESS to help you increase production and improve your product

HY SPEED
SEMI-AUTOMATIC
PLUNGER MOLDING
50 to 300 TONS

SPECIFICATIONS
HY SPEED SEMI-AUTOMATIC PLUNGER MOLDING PRESS

Maximum Press Capacity	50 Tons	100 Tons	200 Tons	300 Tons
Die Area L to R, F to B	21" x 20"	24" x 20"	30" x 24"	36" x 24"
Minimum Daylight Between Platens	27½"	28"	31"	35"
Maximum Daylight Between Platens	33½"	34"	40"	44"
Thickness Upper Bolster	10"	10"	10"	10"
Thickness Lower Bolster	5½"	6"	6"	7"
Stroke	12"	12"	15"	18"
Overall Height	9'2"	9'7"	12'0"	12'0" Ext. Below Floor 2'0" Total Height 14'0"
Floor Space S to S, F to B	4'0"x3'6"	4'8"x4'0"	5'6"x5'0"	5'0"x3'6" Pumping Unit 3'8"x6'0"

With the largest markets in history ready, waiting and eager to buy, plants all over the nation are tooling up for top production . . . and no one can afford to be left behind. This Baldwin press offers the features you need, and delivery can be made promptly. The Baldwin Locomotive Works, Baldwin Southwark Division, Philadelphia 42, Pa., U. S. A. Offices: Philadelphia, New York, Boston, Washington, Chicago, Cleveland, St. Louis, Detroit, San Francisco, Houston, Pittsburgh.

OTHER BALDWIN PRODUCTS: Hydraulic presses, Testing equipment, Steel forgings and castings, Diesel-electric locomotives, Diesel engines, Metal plate fabrication, Rolled steel rings, Bronze castings, Heavy machine work, Crane wheels, Bending rolls, Plate planers, Babbitt metal, Alloy iron castings, Briquetting presses.

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SOUTHWARK
HYDRAULIC PRESSES

* PLASTIC BULLETS FOR TARGET SHOOTING

PLASTIC TOYS TO CATCH
A CHILD'S FANCY *

If your new product calls for a plastic part — injection molded to precise specifications — *Universal Plastics* may be your best bet.

Our design engineers are at your service to help you plan new products and product improvements.

Call or write.

Universal Plastics Corp

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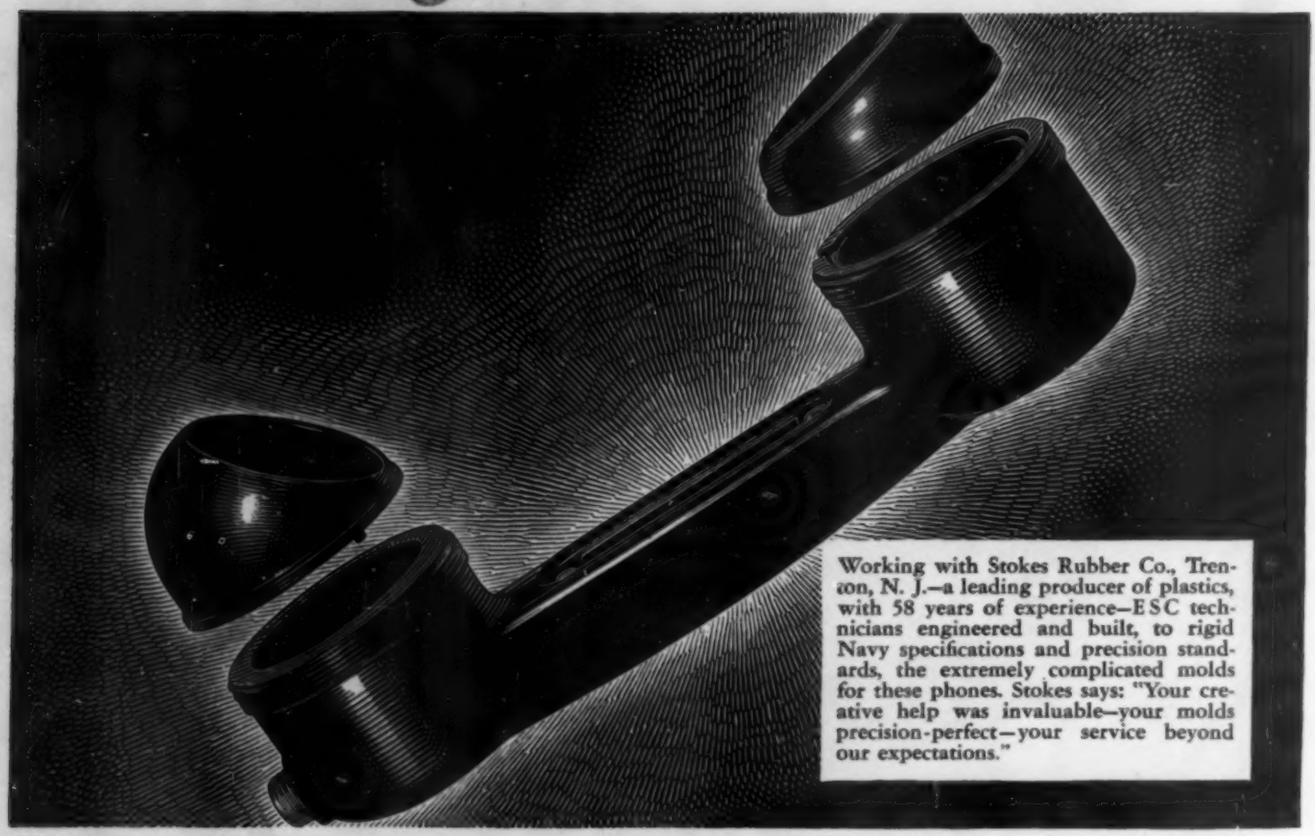
Phone: MUrray Hill 5-3950
Plant: NEW BRUNSWICK, N. J.

Battle Talk signs off!

● Joyous V-J Day news was strange talk to be coming over "intercom" phones aboard Uncle Sam's battle-wagons! Vital cogs in ship-wide communication systems during combat, these instruments are not just ordinary telephones. They are *sound-powered,* operate independent of the ship's electrical wiring, and are intricate in construction. They must work *right,* in battle. *And they did.*

Now their wartime mission is accomplished—and so is ours, in supplying many of the molds for their production.



Working with Stokes Rubber Co., Trenton, N. J.—a leading producer of plastics, with 58 years of experience—E S C technicians engineered and built, to rigid Navy specifications and precision standards, the extremely complicated molds for these phones. Stokes says: "Your creative help was invaluable—your molds precision-perfect—your service beyond our expectations."

Now let's talk BUSINESS!

IF YOU'RE IN the market for plastic molds, here are three reasons why you'll find E S C an experienced, capable and dependable firm to do business with:

1. Even before the war, our staff of experts were nationally known authorities on plastic molds and molding. Added to this is the experience gained during wartime in designing and making highly intricate types of molds, such as those for the vital, sound-powered Navy phone above.

2. Among E S C customers are many of the most prominent molders in the country, for whom we have designed, engineered and produced a wide variety of precision-built plastic molds. References will be furnished on request.

3. E S C facilities have been expanded to meet peacetime demands. New equipment of the most modern design has been added. You are assured of prompt delivery on any type of mold you may require.

We're prepared to work with you from the design stage right on through to the finished product. Your inquiry is invited. Why not write, wire or phone today?

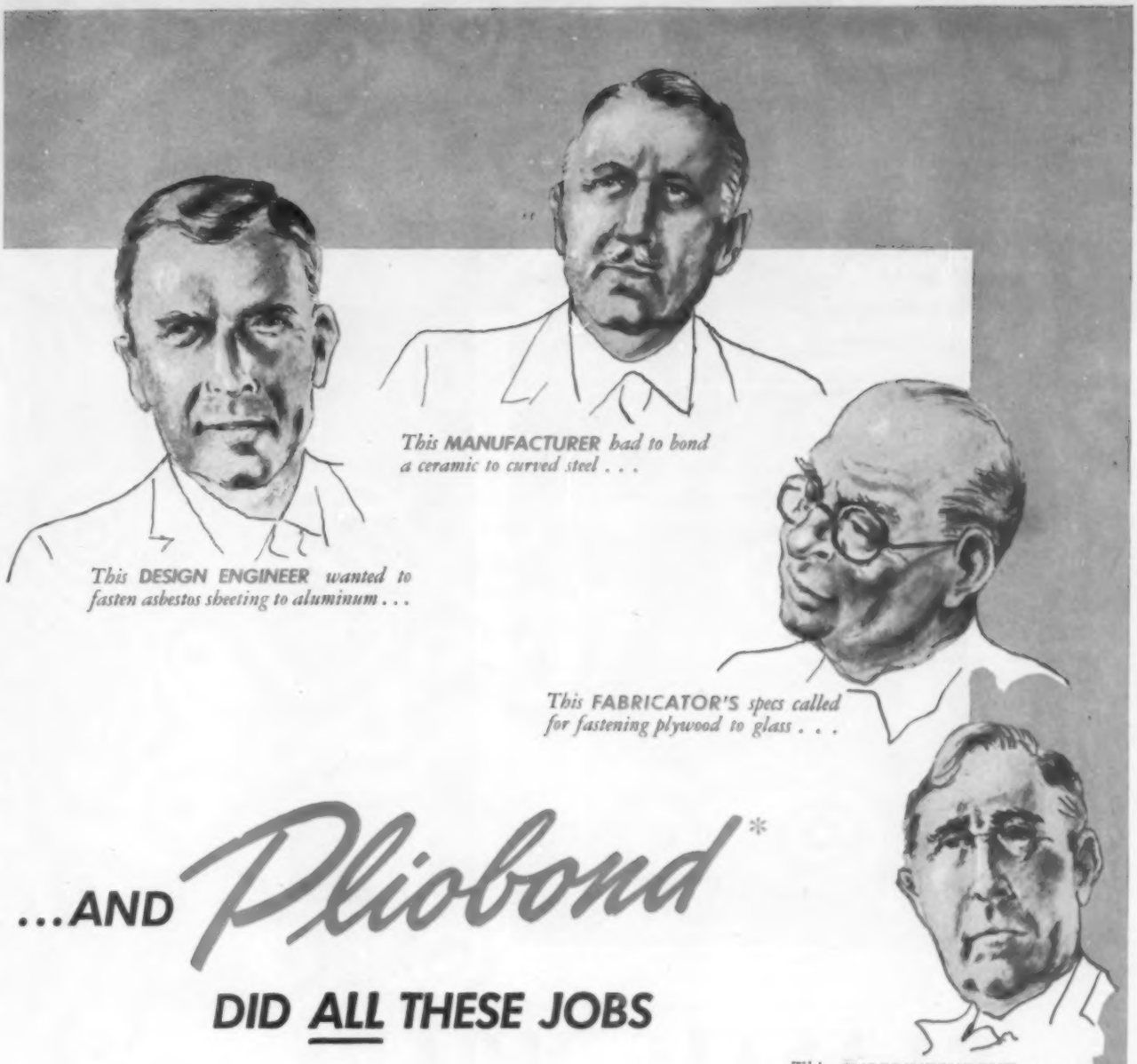
ENGINEERING SPECIALTIES CORPORATION

3476 Gibson, Detroit 1, Mich. • Telephone: TEmple 1-4361

PRECISION esc *BUILT*

PLASTIC MOLDS

Compression • Injection • Transfer



This **MANUFACTURER** *had to bond a ceramic to curved steel . . .*

This **DESIGN ENGINEER** *wanted to fasten asbestos sheeting to aluminum . . .*

This **FABRICATOR'S** *specs called for fastening plywood to glass . . .*

This **SUPERINTENDENT** *was looking for a quick way to fasten glass wool to copper . . .*

. . . AND *Pliobond**

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This one agent, Pliobond, will firmly join *any* materials . . . like or unlike . . . solid or porous . . . flat or curved. No high pressure or heat is needed, except when exceptionally high shear strengths are needed . . . then moderate pressure and 200-300 F. give amazing results.

Because it is a *one*-part bonding agent, there are no fussy mixtures . . . no exact weighing . . . no critical temperatures. It can be brushed, sprayed, spread or roller coated.

Write us for technical information directed to your own adhesive requirements.

Pliobond **BONDS ANYTHING TO ANYTHING**

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Industrial Adhesives Division: 55 West 44th Street, New York 18, N. Y. • Branches in Principal Cities

***PLIOBOND* is a product of* THE GOODYEAR TIRE & RUBBER COMPANY • *Trademark registered, The Goodyear Tire & Rubber Company**

Allied
WITH MASS PRODUCTION

PLASTIC MOLDS

THESE molds made by Allied for the production of inner panels of modern refrigerator doors typify the work being done for many of the country's leading plastic molders.

For years, Allied has been a large producer of quality molds for plastics fabricators. The facilities built up and the experience gained during this time are now being applied to plastic molds which meet every present-day specification for accuracy of form and required degree of surface finish.

If plastics are to play a part in the manufacture of your present or contemplated products, you will find Allied a most dependable source for your molds.

ALLIED PRODUCTS CORPORATION

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DETROIT 8, MICHIGAN

PRECISION • EXPERIENCE • DEPENDABILITY
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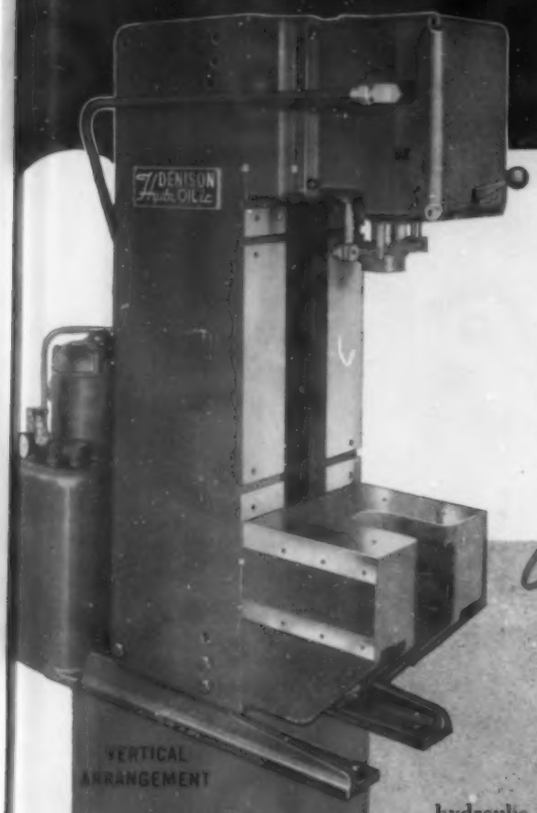
SPECIAL COLD FORGED PARTS • STANDARD CAP SCREWS • HARDENED AND PRECISION GROUND PARTS • SHEET METAL DIES FROM THE LARGEST TO THE SMALLEST • JIGS • FIXTURES • STEAM-HEATED PLASTIC MOLDS • SPECIAL PRODUCTION TOOLS • R-B INTERCHANGEABLE PUNCHES AND DIES • DIE MAKERS' SUPPLIES

Hydraulic Power *and* STARTLING CONTROL OF IT!

READY TO ADAPT TO YOUR SPECIAL REQUIREMENTS!



VERTICAL ARRANGEMENT

VERTICALLY TILTED ARRANGEMENT

HORIZONTAL ARRANGEMENT

Here, in MULTI-UNITS, is complete oil-hydraulic power . . . as packaged components, ready-to-operate, and standardized . . . for easy, economical application to your special machinery or production equipment wherever 4 to 6-ton pressures are required. Or, there's a standard MULTI-UNIT Frame which complements the Pumping Unit and Power Head and may be used in any of four different positions, as a complete machine tool in itself!

Unlimited FLEXIBILITY OF ARRANGEMENT

Two assemblies . . . Pumping Unit and Power Head . . . form the working parts of MULTI-UNIT HydrOILic power. The Pumping Unit may be located anywhere adjacent to the Power Head. It includes electric motor, hydraulic pump, reservoir, and pressure regulating valve . . . is available in 4 and 6-ton capacities.

The Power Head can be applied to machines of your design, or used on the Standard Frame. It incorporates hydraulic cylinder and ram, control valve, control lever and adjustment devices . . . is available in five models for an amazing variety of ram actions, including manual or automatic control, rapid traverse and regulative pressing speed, automatically repeated pressure strokes, automatic ram cycling, and the now-famous Vibratory HydrOILic Pressure. Ram pressures are closely limitable up to 4 or 6 tons. Ram strokes are regulative between ⅛ inch and 6 inches.

The Standard Frame may be used in four different positions—horizontally, by using legs which are available in two lengths—vertically, and vertically-tilted 10 or 20 degrees, by means of standard feet. Maximum daylight opening when using the Standard Frame is 24 inches—minimum 12 inches. Maximum depth from centerline of ram to frame throat is 8 inches. Standard, interlocking accessories, such as indexing tables and ejection cylinders, are applicable to these Multi-Units.

Thus, Denison engineers offer industry all the features of smooth, positive, and easily-controlled HydrOILic power in a form which you can apply to your particular production needs quickly and economically. Write today for additional information.

PUMPING UNIT

POWER HEAD (MANUAL CONTROL)

POWER HEAD (AUTOMATIC CONTROL)

THE DENISON ENGINEERING CO., 1176 DUBLIN ROAD, COLUMBUS 16, OHIO

DENISON
EQUIPMENT *for* APPLIED
HydrOILics

SAFETY

FIRST:

Away with rejects! Leominster Injection Molder requires only one adjustment of One screw for precise die-alignment, preventing flooding.

SECOND:

Toggle-trouble is eliminated by full-length toggle pin support — and — "Centralshaft" centralized movable plate support assures equalized pressure distribution.

THIRD:

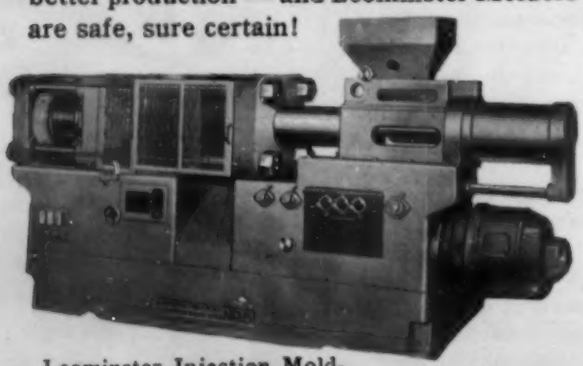
Machine cannot function when EITHER door is open, nor when either of the two independent safety factors becomes inoperative.

FOURTH:

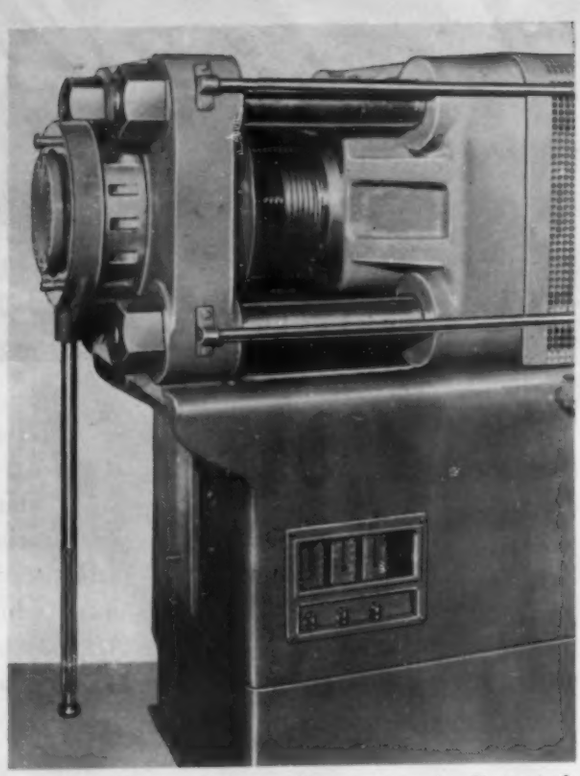
Ejection parts' erosion, cramping, breakage, are done away with by uniform thrust of the multiple knock-out pin assembly.

and FIFTH:

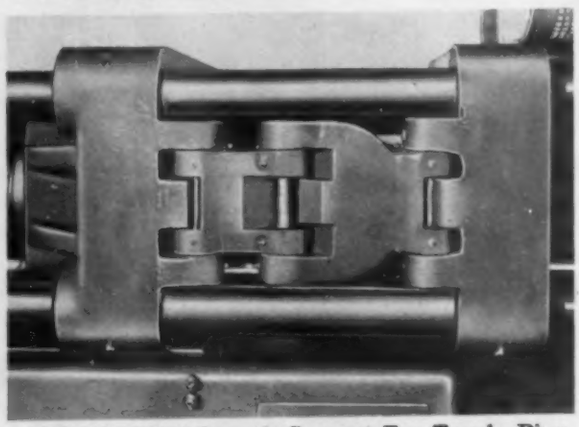
An efficient machine assures an efficient operator — each influences the other — for better production — and Leominster Molders are safe, sure certain!



Leominster Injection Molding Machine No. 5, Series 44.



Single Screw Die - Alignment; A Patented Leominster Feature.



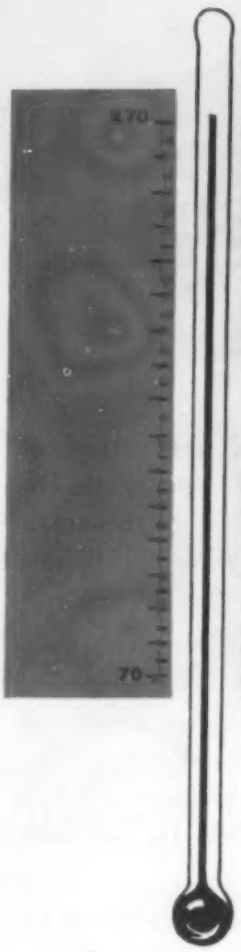
Massive Full-Length Support For Toggle Pins

Leominster Injection Molding Machine No. 5, Series 44, termed "the molder with a brain" by plastics experts and operators, is one of a comprehensive line of plastics molding machinery produced by Leominster. May we send you a recent folder describing molds, molders and granulators?

LEOMINSTER TOOL CO., Inc.

LEOMINSTER, MASSACHUSETTS

MANUFACTURERS OF MACHINES, TOOLS AND DIES FOR THE PLASTICS INDUSTRY



70° to 270°
in 90 SECONDS

IN 5 LB. PREFORM
with new power packed
Thermatron
HEATMASTER

Thermatron compact mobile electronic heaters range from 500 watts to 30 kilowatts. Built by Radio Receptor Company, Inc., a leader in the field of electronic heating equipment, Thermatron Heatmaster, Heatmaster Jr. and Weldmaster are designed to meet every pre-heating requirement in the plastic industry.

Through the use of electronic heating, production increases up to 50 per cent have been obtained in a wide number of fields of manufacturing, including plastics, rubber, plywood, drugs, chemicals, textiles, ceramics, paper, food and wood. Every Thermatron unit is completely guaranteed by Radio Receptor Company, Inc., with nation-wide service.

If you have an unusual heating problem that cannot be met by the Thermatron standard line, our engineers are prepared to provide the equipment that will meet your specific requirements.

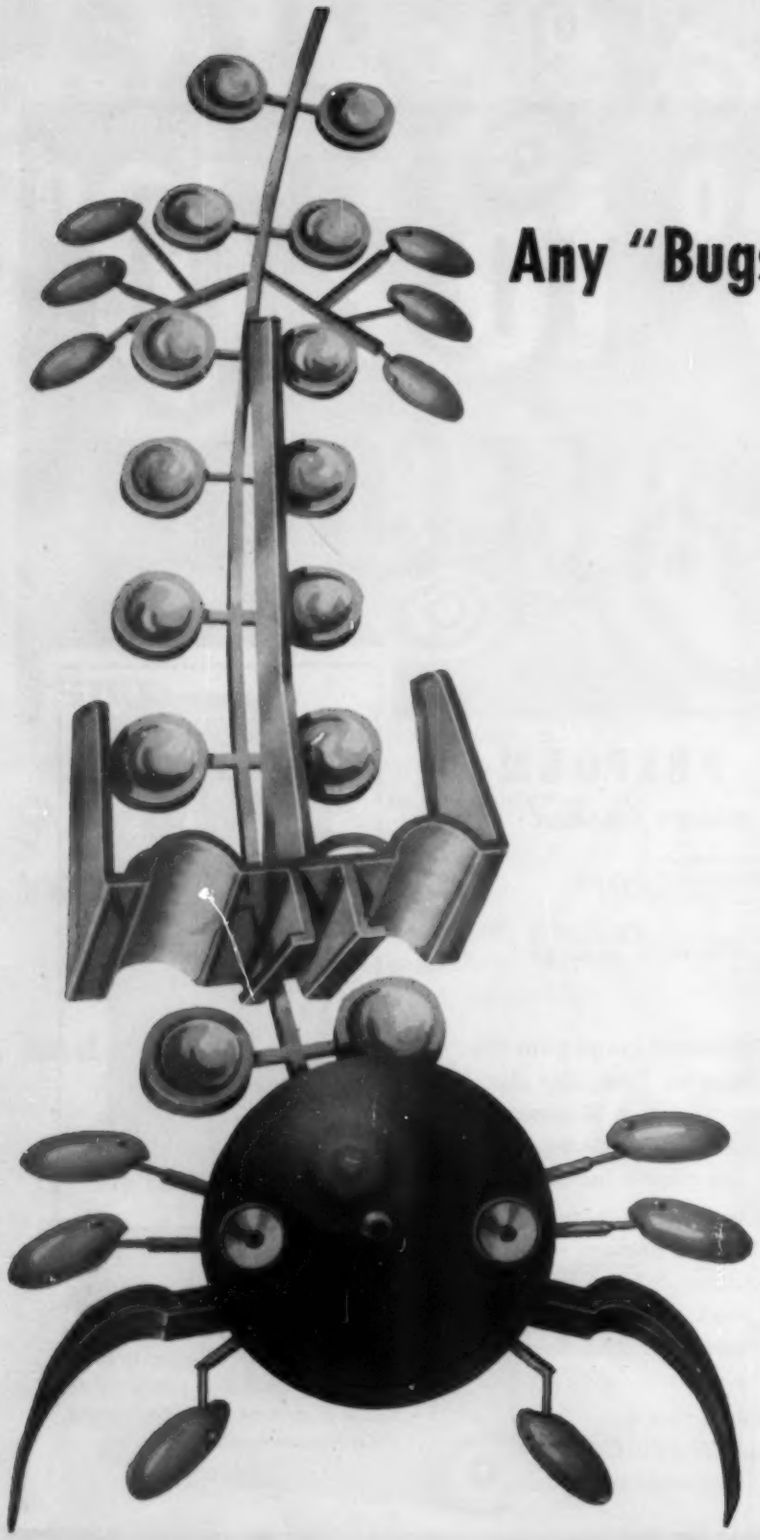
OUTSTANDING FEATURES

Uniform heat, simplified control, low operating cost, adjustable oven, automatic operation, safety for unskilled workers, consistent results, low maintenance.

RADIO RECEPTOR COMPANY, INC.
Since 1922 in Radio and Electronics

251 WEST 19th STREET **NEW YORK 11, N. Y.**

Write for your copy of "Electronic Heating With the Thermatron," our new booklet, on how to make use of this new powerful electronic force to lower cost, to speed production, to develop new products—a comprehensive, practical guide to the application of electronic dielectric heating.



Any "Bugs" in your Product?

If there are, you don't have to send out "feelers" to see if we'll help you out. Exterminating the "bugs" in new products is a job that Continental's Plastics Division is often called on—always glad to do.

Bank on it—our staff of engineers, designers, researchers, is well-equipped to untie your knottiest problem. Long years of experience in working out new products for some of America's best-known manufacturers has given them the necessary plastic "know-how."

The insect alongside shows several examples of Continental's plastic magic. His body is made of flashlight lenses . . . the feet are fishing lures . . . the wings are acid baffles . . . the claws are coffee maker handles . . . the head is a distributor and coil part.

But the list is endless. Set all the plastic items we make on paper and they'd fill this page. Best thing about it, each new day brings a new use. Perhaps plastics and Continental's plastic engineers can help *you* improve or develop your product. Why not drop us a line?

Tune in: "CONTINENTAL CELEBRITY CLUB"
every week over coast-to-coast CBS Network

OTHER CONTINENTAL PRODUCTS: Metal Containers • Fibre Drums • Paper Cups • Crown Caps and Cork Products • Machinery and Equipment.

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FIGHT INFANTILE PARALYSIS • JAN. 14-31

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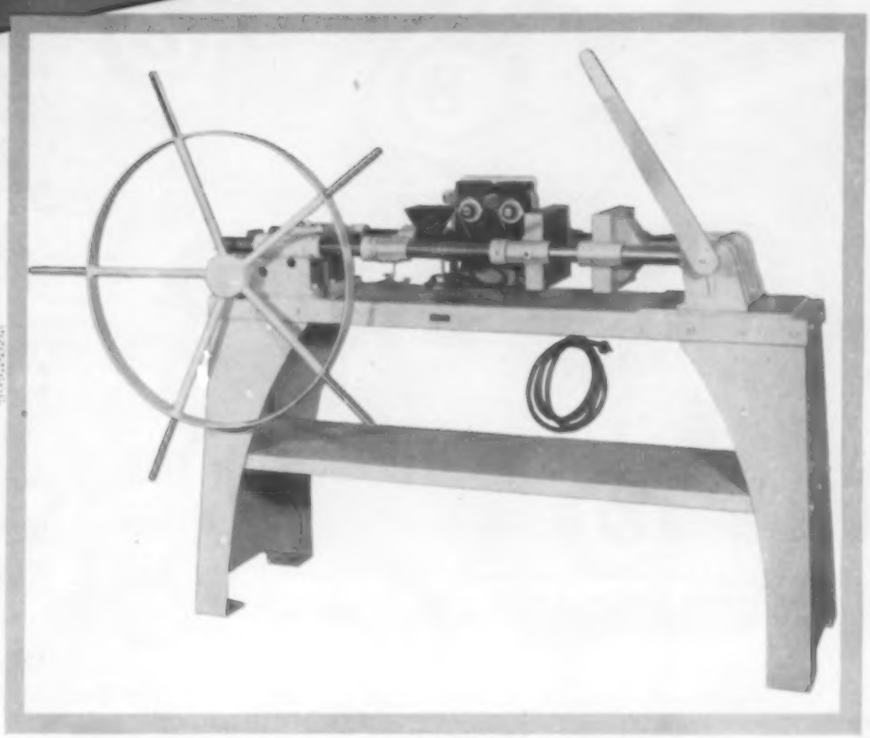
SHEET FORMING • LAMINATION

Van Dorn MIDGET MOLDER

The New Hand-Operated Injection Plastic Molding Machine



for RESEARCH · TESTING · SAMPLING

The Van Dorn Midget Molder is a low cost, manually operated, injection type molding machine for producing plastic shapes up to ¾-ounce in weight. Developed and manufactured especially for laboratory and experimental use and for limited production. It is compact and simple in design and operation.

Available NOW! Write for complete information

Distributors in Principal Cities

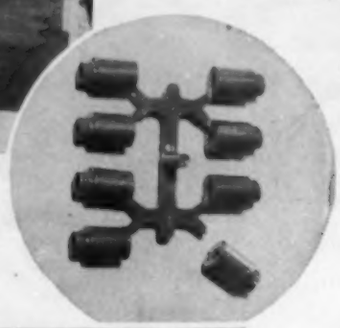
WRITE FOR *Free* ILLUSTRATED FOLDER
which describes the Van Dorn Midget Molder and its applications.

THE VAN DORN IRON WORKS CO.
2087 EAST 79TH STREET • CLEVELAND 4, OHIO

Injection MOLDING

NUMBER 13 OF A SERIES

Above—A section of the Commonwealth Plastic Company factory, showing 10 of the 15 Lesters in operation. This is one of the highest production injection molding plants in America.

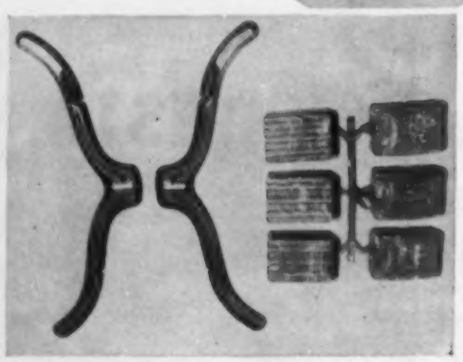


Below—These two pictures illustrate the change from military to civilian work. The chief molding problems in making coat hangers and soap containers are to fill large-area cavities and to attain the required surface luster. In making the timing adaptor for explosives in an 8-cavity mold, it was necessary to maintain 4 different dimensions—core size, outside diameter, thread size and slot size—within the tolerance of .003". More than 9,000,000 adaptors were made by Lester machines without a single complaint from Government agencies. Even though these parts are made of polystyrene, which flashes easily and contains no lubricant, no flashing occurred and no polishing was necessary. This is due largely to proper plasticization in the Lester heating cylinder, and to the heavy beam-type alloy steel frame and double-toggle positive mold locking mechanism, which assure flash-free moldings at all times.

THE Commonwealth Plastic Company of Leominster, Massachusetts operates 37 injection molding machines, 15 of which are Lesters.

A custom molder of this size has many more problems than a small molder, because of the endless variety of work which must be produced.

Philip J. Cormier, molding superintendent for Commonwealth, has had ample opportunity to observe Lester injection molding machines in service, and is able to report authoritatively upon their performance. He says—



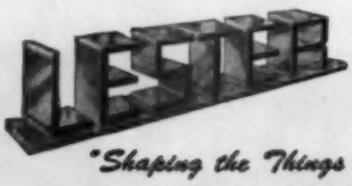
"We are accustomed to running large moldings with heavy sections on our Lesters because we know that Lesters can handle them. We find these machines equally valuable however, in producing large quantities of small parts which must have strength, density, wearability, fine finish and close tolerances. The timing adaptor molding (see illustration) is a good example.

"A big factor in our production is the frequent number of mold changes and color changes which we must make. It is not uncommon for us to use 80 to 100 molds per day, with as many as 200 color changes. We really appreciate the simple, easy, single mold adjustment of the Lester, as well as the facility with which the heating and injection cylinder swings out for inspection changes and cleaning."

The Lesters at Commonwealth operate 24 hours a day, 6 days a week with little maintenance cost. If you would like to know the facts behind the Lester performance, write us today for FREE engineering data.

Investigate These Improvements

Lesters are now built with (1) a new vertical injection cylinder, with solid plunger and internally-heated torpedo, which plasticizes more material at higher speed without burning; (2) a one-piece, cast steel, box-type frame, exclusive with Lester, which provides up to 600 tons locking pressure and eliminates the wear and weaving which are characteristic of ordinary frames; (3) greater mold opening and exact control of opening, which permits use of larger molds and speeds cycling; (4) larger diameter die height adjusting screw, eliminating possibility of mold deflection (adjustment by single hand crank); (5) automatic hydraulic ejection, standard on large machines; (6) flow control system permits separate control of injection speed and pressure; (7) new Lester safety gate is interlocked hydraulically, electrically and mechanically.



INJECTION MOLDING MACHINES

"Shaping the Things of Tomorrow"

National Distributors:

LESTER-PHOENIX, INC., 2711 Church Ave., Cleveland 13, Ohio

Check these 5 new outstanding characteristics of ACRAWAX C

1. anti-block
2. anti-tack
3. speeds up production by eliminating "stick" on the mill or calender
4. mold and die lubricant
5. moisture and solvent resistance

Small percentages of high melting point (280°F.) ACRAWAX C incorporated into plastics and elastomers are producing excellent results.

TYPICAL SUCCESSFUL APPLICATIONS:

Unsupported films or sheets—vinyls, Neoprene, GR-S, for anti-block and anti-tack.

Coatings—vinyls, polyvinyl butyrals, nitro cellulose, for anti-block and anti-tack.

Molded articles — synthetic elastomers, thermoplastic and thermosetting resins, for mold release.

Hot melts—of many types and for many purposes, as those used for coatings, impregnations, sealants, potting compounds, etc., have benefited greatly from the desirable characteristics of ACRAWAX C.

IN ADDITION to solid and granule form ACRAWAX C is available as

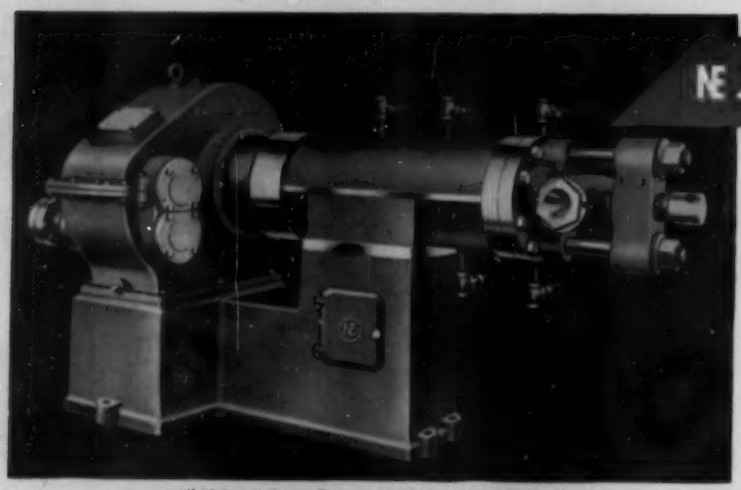
1. **POWDERED** — approximately 100 mesh
2. **ATOMIZED** — approximately 3 microns

In these finely divided forms, greater ease of processing and incorporation into the blend is obtained.

For further information on ACRAWAX C write to Dept. M. P.

GLYCO PRODUCTS CO., Inc.

26 COURT STREET, BROOKLYN 2, NEW YORK



3½" NE Single Stage Extruder with two zones of heating

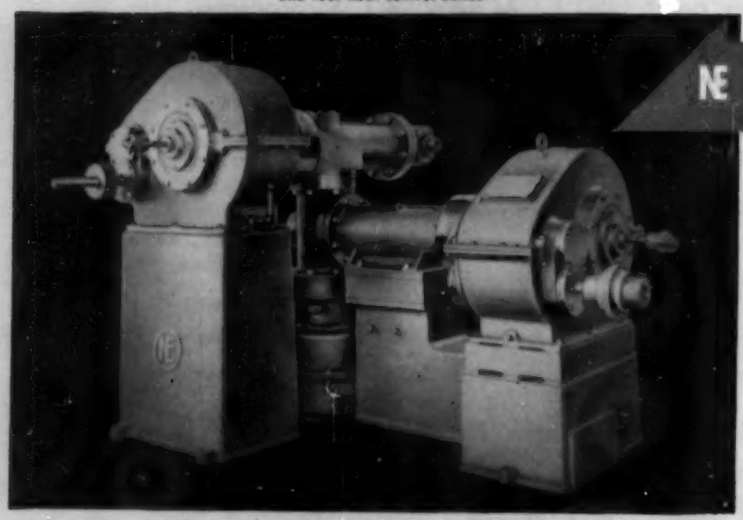
NE *Single* STAGE EXTRUDERS

are widely used where materials are readily plasticized. Illustrated is a 3½" Resin Extruder with special cylinder construction and two zones of controlled heating.

3½" NE Dual Stage Extruder features two stages of plasticizing and four heat control zones

NE *Dual* STAGE EXTRUDERS

were developed to meet special material characteristics. National Erie, as a pioneer builder of extrusion equipment for rubber products, has developed special extrusion machines for plastics users. The dual extruder illustrated is a very recent development.



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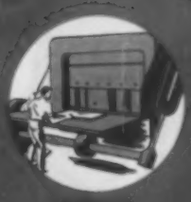
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MODERN PLASTICS
VOLUME 23 JANUARY 1946 NUMBER 5

What's ahead for 1946

On the basis of a quick survey of key industries, it appears that many of the bottlenecks presently hampering the plastics industry will have disappeared by the summer of 1946

CAN the plastics industry supply its potential customers with all their needed materials in 1946? To find an answer to this question, MODERN PLASTICS has conducted a survey of the processors and raw materials producers with the result that while we cannot offer a yes or no answer, we can, at least, give an idea of what the plastics industry thinks it can do during the year ahead.

One thing is certain. Plastics customers are asking for far more than industry can provide at present—many deliveries running from 1 to 4 months behind schedule. But the same thing applies to nearly every other industry. Furthermore, plastics industry leaders feel that possibly one-third of the present demand is artificial because, as it was so aptly phrased by P.M.M.A. president W. Stuart Landes, "molders sometimes duplicate orders placed with different producers in the hope of getting larger allotments." He also pointed out that newcomers would find difficulty getting any share of the cellulose supply until production capacity increases.

The American tendency toward impatience is apparent in all phases of the plastics situation. The general public has heard so much about the new products that they want to have a look right now. Processors are impatient with producers because deliveries are slow and orders are cut. Producers are impatient because bottlenecks in acquiring new facilities are hard to break. But it seems certain that within 6 months' time these troubles will be at least partly in the past; and normal full capacity operations will have become well organized; and production will be steaming along at a furious pace with customers fairly well assured of a date upon which their orders for various plastic parts will be delivered.

Unless economic and political factors intervene, it seems reasonable to believe that the plastics industry will be well on its way to surpassing a 161 percent increase predicted for it in the Committee for Economic Development study, hampered only by the growing pains of any lusty young enterprise that is on its way to the top.

The past as a measure of the future

According to every known survey, consumers in the United States are going to be in the market for more materials in 1946 than in any time, or year, in the nation's history. If the world doesn't go haywire in trying to settle postwar political problems and if labor and management can work out amicable agreements, many economists believe that this unsatisfied demand for goods will extend over at least a 5-year period.

Because the plastics industry is so largely concerned with supplying parts and finished items to other industries, the expansion of the consumer durable goods, automobile, construction, transportation, textile, paint and varnish, and electronics fields leads to the conclusion that plastics must also expand if it is to keep up with increasing demands of its growing customers.

Committee for Economic Development report—In this connection it is interesting to observe the report of the Committee for Economic Development under the chairmanship of Paul G. Hoffman. The Committee took pains to point out that it was impossible to make out a scientifically accurate report on the exact total of dollars that would be spent or the number of products that would be produced in postwar years, but that their research did correlate the opinions of more than 1500 manufacturers and trade associations. It so happens that the forecasts are for 1947 which was estimated to be the year when production would reach full capacity. This particular article in MODERN PLASTICS pertains only to 1945 and 1946, but attention is called to the CED forecasts (Table I) because trends and progress in most industry activities will probably follow the same pattern in 1946 as in 1947 although the total sales volume or production total may be smaller in 1946.

It is noteworthy that the CED estimate for increased percentage volume of plastics materials is far greater

TABLE I—COMMITTEE FOR ECONOMIC DEVELOPMENT FORECAST FOR 1947

	Value of products at 1939 price level (millions of dollars)		*Estimated increase 1947 over 1939*
	1939	*1947 estimated*	
			%
Linoleum and other hard surface floor coverings	69.9	110.6	58.2
Plywood mills	38.9	69.9	79.7
Upholstered house furniture	128.7	199.1	54.7
Household furniture except upholstered	328.6	478.2	45.5
Office furniture	54.8	84.6	54.4
Public building furniture	26.7	40.6	52.1
Laboratory, hospital and professional furniture	14.7	25.8	75.5
Window and door screens, weather stripping	15.2	26.6	75.0
Wood preserving	106.3	172.8	62.6
Bookbinding and related industries	102.6	150.5	46.7
Paints, varnishes and lacquers	435.0	633.0	45.5
Perfumes, cosmetics, toilet preparations	147.5	218.8	48.3
Rayon and allied products	247.1	575.5	132.9
Mucilage, paste and other adhesives	4.2	5.3	26.2
Rubber boots and shoes including rubber soled shoes	50.0	67.9	35.8
Rubber products other than tires and shoes	264.5	402.0	52.0
Footwear, except rubber	734.7	936.4	27.5
Suitcases, briefcases, luggage	36.6	53.1	45.1
Hardware	154.5	213.9	38.4
Stoves, ranges, furnaces, etc.	223.4	317.5	42.1
Clocks and watches	84.8	136.1	60.5
Lighting fixtures	124.6	157.8	26.6
Wiring devices and supplies	94.3	137.5	45.8
Elec. measuring instruments	41.8	56.3	34.7
Electrical appliances	145.7	244.4	67.7
Insulated wire and cable	120.4	168.0	39.5
Automotive elec. equipment	109.8	145.3	32.3
Radios, tubes, phonographs	275.9	499.9	81.2
Communication equipment	191.3	275.7	44.1
Vending, amusement and coin-operated machines	23.1	48.7	110.8
Scales and balances	14.4	18.4	27.8
Refrigerators, domestic	278.6	438.5	57.4
Automobiles and equipment	4039.9	7107.5	75.9
Transportation except autos, and car equipment	168.4	360.8	114.3
Aircraft and parts	279.5	552.4	97.6
Photographic apparatus	133.9	203.4	51.9
Games, toys, dolls, etc.	86.6	128.9	48.8
Buttons	4.1	5.4	31.7
Costume jewelry	33.9	41.3	21.8
Brushes	48.5	58.4	20.4
Total all manufacturing*	56,843.0	80,515.0	41.6
Plastic materials	77.7	203.3	161.6
Fabricated plastic products not elsewhere classified	71.9	105.5	46.7

* Many classifications omitted because they are of lesser importance to the plastics industry.

than for any other industry. It is also interesting to note that sales volume of plastics and synthetic resins was $332,000,000 in 1944 according to WPB records. This figure is far in excess of the CED estimate of $203,300,000 in 1947. But it must be remembered that a great portion of the 1944 sales went to such large volume applications as airplane noses and blisters, navy cable, proximity fuzes, M-52 fuzes, coating materials and similar war products. Transferring that volume to civilian applications is going to be quite a task.

The CED figure of $105,500,000 on "fabricated plastic products not elsewhere classified" is probably meaningless because it is all scrambled up with other estimates in the survey. The WPB figure on processed plastics products was $306,000,000 for 1944, but even that sum is subject to question because there has never been a clear-cut distinction between what is and what is not a plastic end product. Until a more definite breakdown of statistics is available it will always be difficult to ascertain total volume of finished plastics products.

Civilian Production Administration report—The latest survey on 1946 trends which we were able to obtain was a Civilian Production Administration report of November 15, 1945. This survey is of the 55 metal working industries only, but as they probably form the largest segment of manufacturing activities in both dollar volume and employment, and include a great share of the market for plastics, this report may be taken as indicative of industrial progress on a broad base.

The Civilian Production Administration report says that by the middle of 1946 shipments by the metal-working industries—valued in current prices—will be three times the average 1939 rate. If measured by the 1939 price level *the increase in shipments will be about two and one-half times the 1939 rate.*

These same metal-working industries report that their anticipations for June 1946 shipments will put them on an operating capacity at a level equal to about 80 percent of the first quarter of 1945, which of course means that their civilian business will be about 20 percent short of their war business but still two and one-half times better than 1939. These same industries indicate that their employment will double the 1939 level by June 1946. If employment is doubled, it seems logical to believe that production is due for at least an equal increase.

It would not be surprising if the metal trades industry runs ahead of many other manufacturing enterprises in increased production after the war because of its particular position during the war. Its production lines were almost completely changed over to special products for war use and the demand for its products such as automobiles, refrigerators, machinery, etc., has grown so tremendously that it may take a long time to satisfy all the potential customers who were cut off during the war years.

This situation is important to the plastics industry because the metal trades group is one of its best customers. Plastics were just beginning to get into the field

Assuming that the same amount of plastics will be used in the 1946 car as was used in the 1942 model, parts produced from thermosetting materials will weigh 1.2 lb.; from cellulose acetate or cellulose acetate butyrate, 3.37 lb.; from methyl methacrylate, 0.046 lb.; and from the phenolic laminates about 0.68 pound

PHOTO, COURTESY FORD MOTOR CO

before the war. Thus if the metal trades increase their production two and a half times by next June it is to be assumed that their demand on the plastics industry will be for even more than two and a half times the plastics they used in 1939 or 1940. Whether or not they can get it is something else again.

The Civilian Production Administration report on the metal trades industry is considerably more optimistic than the CED survey appearing on page 92. According to the CED survey, all manufacturing production in 1947 will increase slightly less than half again as much as in 1939. But total production is something far different from production in the special categories in which plastics are interested and the CED survey indicates that the plastics industry's principal customers' demands run far ahead of the general consumption total in many instances. Furthermore, the CED survey gives unmistakable evidence that plastics are expected to capture this increased market by predicting a raw materials output for 1947, which is more than two and a half times its 1939 dollar volume, an amount far greater than that of any other industry.

Always bear in mind that these surveys are based on a quick return to normal political relations between nations, a fairly rapid adjustment to economic stability in the devastated nations and amicable relations between labor and management. Any serious eruptions or long-drawn-out disputes in these fields would upset calculations and change the outlook.

It is impossible to go into every particular field where plastics are used. Consequently, we have selected a few of the most representative industries and will attempt to outline some of the potential demand and supply possibilities. It is believed that those not mentioned here will follow about the same pattern.

This is no attempt to figure out demand to the last ounce, but simply to name the factors involved and indicate trends that may be expected. Statistics in the plastics industry are extremely complicated and difficult to compile. Most of the information given here was obtained by interview, by telephone or correspondence with informed men (customers and suppliers).

Automobiles

There are as many estimates on the number of automobiles to be manufactured in 1946 as there are magazines in which to print them. A Civilian Production Administration news release of Nov. 15, 1945 reports that production may reach a rate of 500,000 passenger cars monthly by June 1946. According to this figure, 3,000,000 cars could be produced in the last half of 1946 plus at least 1,500,000 in the first to give a total of 4,500,000 for the year. According to the CED estimate, the industry expects a 76 percent increase in dollar volume for 1947 over 1939. Even making allowance for a greater number of small cars, this could not amount to many more than 3,400,000 cars if the change in price levels is taken into consideration.

An automobile executive sniffed at the 500,000 production rate forecast by the Government for June 1946. "Too many things going wrong—that production would be at a rate greater than ever achieved. The industry has never produced more than 4,500,000 and that was the peak year of 1929. The next best was 1941 when slightly over 4,200,000 were sold."

General Motors, who produced more than 50 percent of all passenger cars before the war, have flatly stated that even if there were no labor troubles their 1946 production would be substantially the same as 1941 because new construction facilities will not be available until late 1946. The Chicago Motor Club has estimated production as low as 2,000,000 cars.

From all this welter of pessimism and optimism it is apparent that no one is assured of the actual result. For the purpose of this article, we will figure on the plastics that may be used on 3,500,000 cars for 1946—a figure between the lowest and highest estimates.

How much plastic will be used per car?—There is no

N. O. BRODERSON
President, S. P. I.

"At no period in the history of the plastics industry have we experienced the technical progress that has been made during the past 5 years. With few exceptions, the plastics materials, which were available in 1940, had been greatly improved by 1945. Many new plastics have made their appearance which, because of certain unique characteristics, have made possible the application of plastics in many items where formerly no suitable plastics were available.

"The introduction of high-frequency heating has greatly increased the output of the industry, especially in the field of large moldings, with a definite improvement in quality. Better injection equipment, a greater "know-how" by the industry as a whole, has resulted in a general improvement of all plastic articles.

"It is true that many plastic articles were made during the war in substitution for similar articles formerly made from metal. The industry can expect die castings, metal stampings, etc., to recapture some of this business; but many of the items may reasonably be expected to remain in the plastics family.

"I am advised that further expansion by the plastic material manufacturers is expected. Discussions with plastic machinery manufacturers lead me to believe that, collectively, they have in process and on order as many injection molding machines as now exist in the industry. The producers of extrusion equipment approach a like condition.

"I, personally, discount the optimism of the molders and fabricators with whom I have talked by at least 50 percent. In many cases, two or more may be equipping to produce the same identical order. Nevertheless, it is my personal opinion that the total volume of plastics will expand over and above the wartime consumption."

evidence to indicate that more plastics will be used per car by any of the old companies for the 1946 passenger car than were used in the 1942 model. The 1946 model, for the most part, is simply a reproduction of the last prewar model.

Several announcements have been made concerning new cars that will use structural plastics parts in plentiful quantities, but it is doubtful that they will get into large production during 1946.

Another point to consider is that plastics were sometimes used to replace small metal parts in the 1942 cars due to the chrome shortage and it is unreasonable to believe that the desire of some designers and engineers to return to metal can be overcome.

Plastics in the 1942 car—In order to estimate how much plastics will be used by the old line automobile companies for the cars to be produced in 1946 we have taken a typical 1942 car as an example. Parts molded or fabricated of thermosetting materials weighed 1.2 lb.; of cellulose acetate butyrate or cellulose acetate, 2.12 lb.; of methacrylate 0.046 pound. Phenolic laminated parts weighed 0.68 pound. The plastics applications ranged from thermoplastic knobs, door trim, etc., to thermosetting switch assemblies, spark plug covers and other electrical applications.

On an average car, there are, besides the parts accounted for above, from 1.25 to 2 lb. of cellulose acetate butyrate or cellulose acetate on the steering wheel, 0.3 lb. of phenolic resin in a brake band and 1.9 lb. of polyvinyl butyral in the safety glass.

Added up, these parts account for 7.496 lb. of plastics—and no vinyl has yet been mentioned except that used in safety glass. No other vinyl was used in 1941, because it was not available, but today a considerable amount is in demand—at least suppliers are behind on orders for vinyl materials to be used on auto parts. One car is using a vinyl tube rear deck water seal, grommets, connector sleeving and a 3- or 4-oz. shield over the distributor cap. The total amount weighs more than one pound.

The total amount of plastics mentioned thus far adds up as follows for 3,500,000 cars:

Acetate and butyrate at 3.37 lb. per car	11,795,000
Phenolic (molded) at 1.20 lb. per car	4,200,000
Phenolic (laminated) at 0.68 lb. per car	2,380,000
Methyl methacrylate at 0.046 lb. per car	161,000
Phenolic in brake bands at 0.3 lb. per car	1,050,000
Polyvinyl butyral in safety glass at 1.9 lb. per car	6,650,000
Molded or extruded vinyl for 1/4 total number of cars at 1 lb. each	875,000
Total plastics for 3,500,000 cars	27,111,000 lb.

This figure is regarded by authorities interviewed as the absolute rock bottom plastics poundage that will be required if 3,500,000 1946 model cars are produced during the year. Note that the amount of cellulose acetate and cellulose acetate butyrate is about double the monthly production capacity of these two thermoplastics at the end of the war and is considered a very conservative estimate.

The reader will note that little mention has been made of acrylics although there were 70 such applications on the last prewar cars. Frankly we have not been able to check on these applications although it is known that some of the radiator ornaments have been discontinued. On the other hand, there are several producers who will use acrylics on a number of their

higher priced cars for such applications as horn buttons, medallions, speedometer panels and various other items where edge lighting is desirable.

In addition to the above-mentioned plastics parts, some autos also use a laminated instrument panel, or dashboard that may weigh as much as 2 pounds.

Figures on plastic upholstery are not included because the materials are not yet ready or available in great quantity for use in passenger cars.

From the above listed items it seems safe to estimate that nearly 30,000,000 lb. of plastics will be used in 1946 model passenger cars alone if the industry reaches the 3,500,000 car goal during the year.

Plastics in the 1947 car—How much plastics will be used in 1947 model cars that may be built in 1946 is beyond reckoning. Motor company officials are extremely reticent in discussing their plans. It seems certain that some decorative parts, metal as well as plastics, will be completely abandoned by some designers. But plastics will certainly not fade out of the picture as some of the defeatists proclaim.

Most plastics industry members know about certain parts that have not been satisfactory, largely because of misapplication. But it is interesting to hear various motor company officials tell how they expect to overcome some of those so-called failures either by redesign or by changing the plastics compound by altering the filler, switching to another type of raw material, improving the formulation and by improved molding technique that was learned during the war.

These improvements on old uses apply largely to thermoplastics. Thermosetting applications have been well established for years and show no signs of falling back—indeed there is every indication that certain types of laminations requiring thermosetting resins will find wide applications in the automotive industry in due time—but probably not on a grand scale in 1946.

Then there will be some new thermoplastic applications such as the doughnut-shaped white sidewall disks which fit over tires and give the appearance of white sidewalls while protecting the tire from scuffing. This application alone will require more material than any present thermoplastic part, but it is not anticipated that many will be used on 1947 cars.

There is more than a little talk about glass fiber fenders on several of the high-priced cars but manufacturers claim that cost is still an unsurmountable obstacle. Rumors of plastic tops have reached a state which indicates that definite announcements may soon be forthcoming.

Perhaps the greatest curiosity in the plastics industry concerns several projected cars with plastics bodies. One, announced in California and called the *Bobbi-Kar*, is to weigh less than 600 lb. with hoped-for eventual annual production of 75,000 units. Another car, reported to feature several plastic innovations, is a three-wheel novelty called the *Californian*. Few people expect either of these two cars to make a great dent in plastics raw materials consumption during 1946. What may be accomplished after that is pure guess.

The plastics car that has caught the imagination is one being designed by William Stout, famous airplane designer who is working on a Graham-Paige model. His ideas about his car are outlined in an article on page 107 of this issue of MODERN PLASTICS. It is doubtful that Mr. Stout's ideas will bear full fruition in 1946 and the amount of plastics consumed this year will be comparatively small.

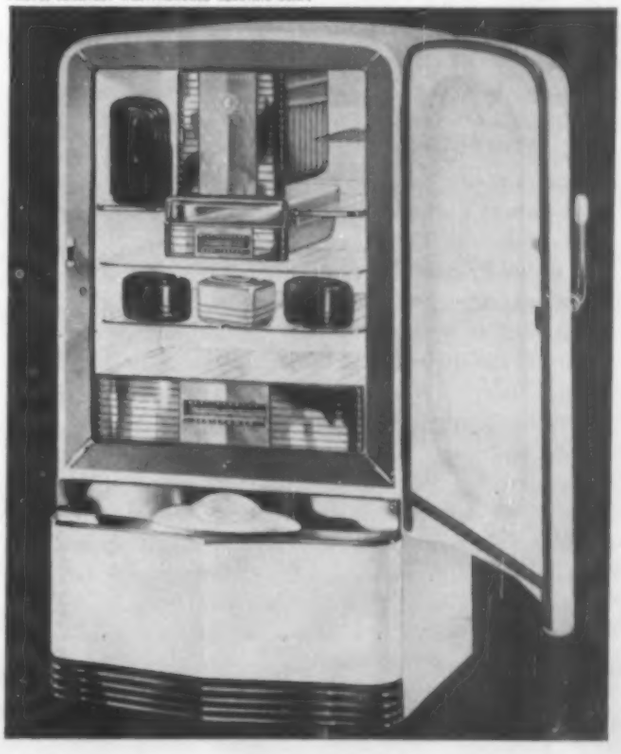
And there are other branches of the automotive field aside from normal passenger cars that deserve attention from the plastics industry. Trucks, for example. The industry hopes to build 1,000,000 of them in 1946, which would be 150,000 in excess of any peacetime year. There is no record of the amount of plastics used—the numerous sizes and types rendering record-keeping of questionable value—but there is no doubt that the amount of molded and laminated phenolic material used per truck exceeds that in a passenger car. Possibilities for plywood and laminated side walls for truck trailers are unlimited.

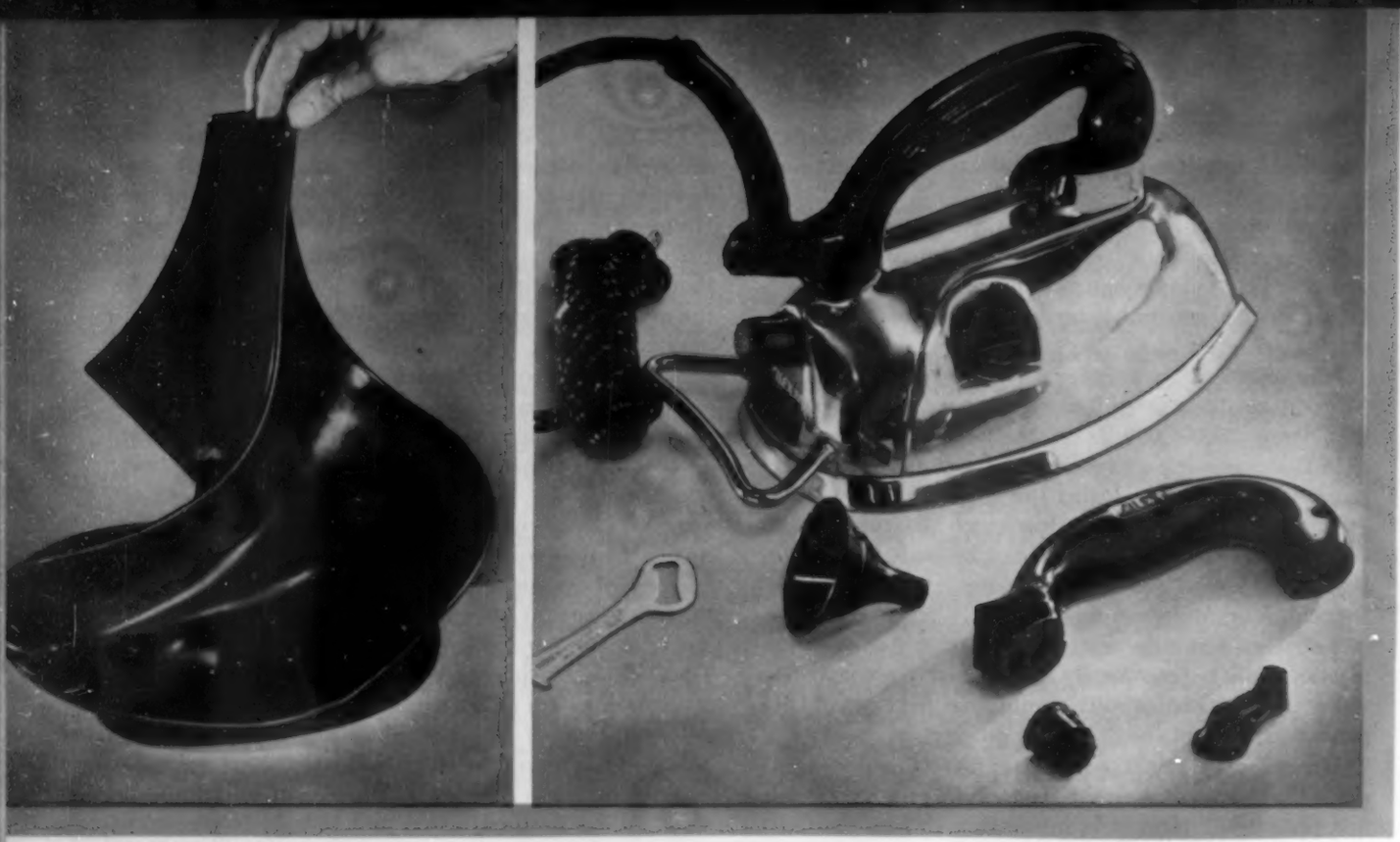
Perhaps one of the most interesting developments in this field has been the extensive use that has been made of artificial leather for truck cab upholstery during the war. It has been estimated that at least 50 percent of all wartime truck-type vehicles requiring coated fabric upholstery used vinyl or coated cloth to replace rubber.

Producers can now obtain synthetic rubber for coating material, but for 1946 at least, they are using whatever is at hand. Plastics materials manufacturers

If the same number of refrigerators are produced in 1946 as the base period 1940–1941, this industry should use about 500,000 lb. of cellulose acetate and cellulose acetate butyrate, 3,200,000 lb. of polystyrene, 18,500,000 lb. of various laminates

PHOTO, COURTESY WESTINGHOUSE ELECTRIC CORP.





PHOTO, COURTESY BAKELITE CORP.

PHOTO, COURTESY DUREZ PLASTICS & CHEMICALS, INC.

Left—The biggest single plastic part in the prewar washing machine was the agitator which weighed from 3 to 5 pounds. Right—If a million irons are produced in 1946—the same as in 1940—about 5,000,000 lb. of plastic will be used for the handles alone

expect to capture at least half this market. And since at least 5 sq. yd. are used for an average truck's upholstery and scuff panels—one yard of fabric requires one pound of vinyl compound—there is a potential market of around 200,000 lb. of vinyl resin a month.

At the moment no one seems to be thinking of artificial leather as a replacement for real leather on higher-priced station wagons or convertibles; but vinyl-coated fabric at between 12 and 15 cents a square foot certainly has some competitive advantages over leather for low cost vehicles.

If artificial leather is widely adopted in the future, the market for vinyls would mount tremendously. Take station wagons, for example. Probably not many will be made in 1946 because producers are too busy with ordinary passenger cars, but they were definitely on the way up when the war stopped their production. About 28,000 were made in 1940 and over 41,000 in 1941. If the increase continues in that ratio and plastics upholstery for scuff panels, seats and top at 15 lb. per wagon is provided for only half of them, it will be a sizable poundage to add to other automotive uses. Then there is also experimental work going on in this same field with convertible coupes, of which almost 100,000 were made in 1940. And it is not impossible to believe that a plastic top for convertibles is beyond realization in the near future—maybe 1947.

The reader will note that we did not include plastics fabrics or coated materials in our anticipated total of nearly 30,000,000 lb. consumption of plastics materials for the year 1946, but there is just too much smoke to convince us that vinyl coatings will be neglected in the automotive industry.

Neither do we give credence to the gloom dispellers who hint that the plastics poundage used by the automotive industries will shrink in 1947. Some applications may be lost but the amount of poundage should be more than replaced by new uses.

Mechanical Refrigerators

Production of mechanical refrigerators in the best prewar year (July 1940 to June 1941) amounted, according to WPB reports, to about 3,700,000 or 316,000 a month. The same report estimates that production in June 1946 may reach 460,000 units a month.

A representative company supplied the breakdown of plastic parts on a typical refrigerator of late design which are listed in Table II.

A little matter of arithmetic indicates that if as many refrigerators are produced in 1946 as in the year July 1940 to June 1941, the amount of plastics needed will be 23,000,000 lb.—515,700 lb. of cellulose acetate and cellulose acetate butyrate; 3,850,000 lb. of polystyrene; and 18,500,000 lb. of laminate figured at 5 lb. per unit.

Washing machines

About 2,000,000 washers were produced in the base period July 1940 to 1941; at least 4,000,000 units are forecast for 1946.

The most attractive part of a washing machine to plastics processors is the agitator which was just begin-

TABLE II—PLASTIC PARTS ON TYPICAL REFRIGERATOR

	Grams	*Ounces*
Butyrate		
8 Rack supports	22	0.78
1 Door knob	27	0.95
1 Evaporator door knob	3	0.11
1 Nameplate	7	0.25
		2.09
Polystyrene		
1 Escutcheon and button for lower front	19	0.67
1 Door front and liner for evaporator	265	9.35
1 Crisper front	188	6.63
		16.65
Laminated phenolic		
1 Control wheel and gear	195	6.88
4 Breaker strips	421	14.85
1 Inner door pan	1635	57.67
4 Food compartment supports	46	1.62
		81.02
Cellulose acetate		
Strike and ctr. rail gaskets	4	0.14
Total plastics used, 6 lb., 3.9 oz.		

ning to come into use when the war broke out. Housewives are said to like them because of their color and because they do not corrode as metal units sometimes do as a result of the action of the soap.

The cost of a plastic agitator, however, is approximately 25 percent higher than that of an aluminum agitator. This increase, while raising the cost of a single machine by only a small amount, is an important consideration in mass production. For this reason, and because molders are not tooled up to produce in great quantities, the plastics industry expects to get only a part of the business in the older type machines.

It is believed that only 50 agitator molds were available at the end of the war and the present tight situation in mold making will slow up production of additional dies. The 50 molds could, however, be used to turn out about 150 agitators a day on a three shift basis, or approximately 45,000 parts a year.

If the plastics industry could fill the orders for agitators on one-fifth of the number of washers manufactured in 1940, or 500,000 machines, it would require 2,000,000 lb. of thermosetting material, assuming the agitator to weigh 4 pounds. Actually, the weight of an average plastic agitator varies from 3 to 5 lb., some going as high as 7 pounds.

There will, of course, be a large number of the new domestic laundry units which do not contain agitators, but even these machines will have some plastic parts.

Electric iron handles

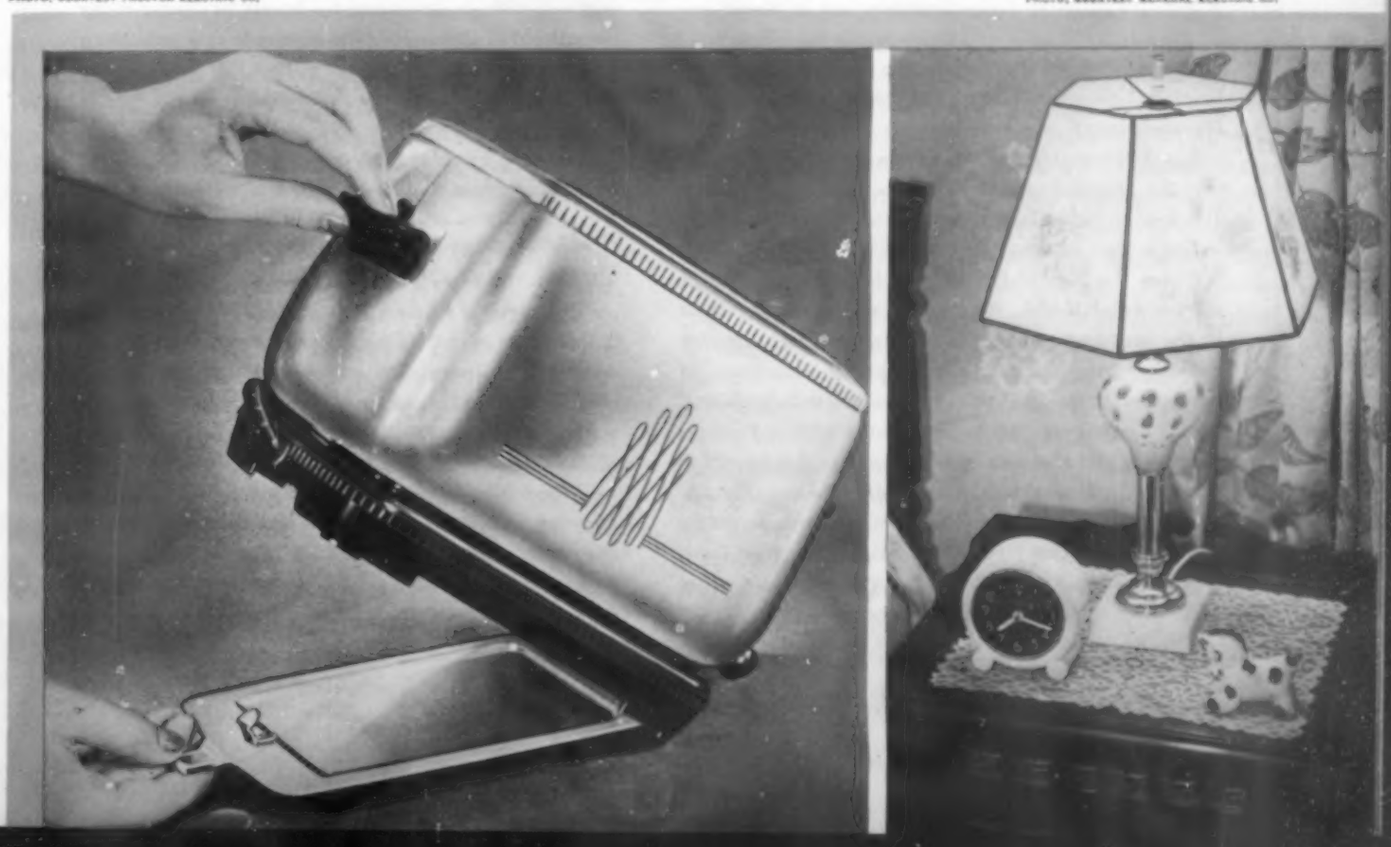
In the base period (1940) about 5,000,000 electric irons were produced. Demand for irons ran ahead of nearly all other items in an Office of Civilian Requirements survey which was made before the war ended. It is presumed that at least as many will be made in 1946 as in 1940, an estimated 1,000,000 being finished or in process by the end of 1945.

Iron handles require from as little as $\frac{1}{2}$ to 3 lb. of plastic material. Three pounds is very unusual; one pound a conservative average. Consequently, if as many irons are made in 1946 as in 1940, approximately 5,000,000 lb. of molding material will be needed. In some cases other materials may be used for handles, but such deflections are corrected by the conservative

Left—Toasters, of which 4,100,000 may be produced in 194x, use from 15 to 20 oz. of plastic per unit. Right—Assuming that only half the clocks which are manufactured have plastic cases, this industry can be expected to use about 1 to 3 million lb. of plastic

PHOTO, COURTESY PROCTOR ELECTRIC CO.

PHOTO, COURTESY GENERAL ELECTRIC CO.



estimate on total production. There is also a definite possibility that a goodly amount of plastics will be used in the electric iron cords.

Vacuum cleaners

A WPB survey estimated that vacuum cleaner production may approximate 270,000 units a month in June 1946. Taking account of difficulties in conversion and a hoped-for monthly rate of around 190,000 in the first six months of the year, the industry could produce 2,750,000 cleaners in 1946, but we will follow our usual procedure and stick to the 1940 production figure of 2,000,000 for our estimates.

There is wide variation in the amount of plastics used in cleaners. It runs from less than 1 lb. to perhaps 4 or 5 lb. in some of the new models. One maker reports the use of a new vinyl piece weighing one pound. Another had a thermoplastic nozzle about ready for adoption when the war began. Yet another vacuum cleaner manufacturer reports that he will use considerably less plastic material in his future cleaners than he did in his prewar model.

The plastics parts of a Hoover Model 27 were listed recently[1] as follows:

Part	*Type*	*Weight, oz.*
Motor hood	Phenolic	12.5
Bag ring	Phenolic	2
Motor case, upper	Phenolic	3.5
Motor case, lower	Phenolic	10
Agitator ends	Phenolic	2
Caster wheels	Phenolic	1.25
Carrier wheels	Phenolic	5.5
Handle socket	Phenolic	0.5
Handle receptacle	Phenolic	0.5
Switch	Phenolic	0.5
Field coil spools	Phenolic	1.5
Furniture brush nozzle	Phenolic	3.5
Crevice tool	Phenolic	3.5
Blower	Phenolic	3.5
Floor brush nozzle	Phenolic	3
Dusting brush nozzle	Phenolic	3
Handle grip	Acetate	1
Furniture brush back	Acetate	0.75
Dusting tool latch button	Acetate	0.1
Head light lens	Acetate	0.1

[1] *Bakelite Review.*

W. S. LANDES
President, P.M.M.A.

"For the Plastic Materials Manufacturers' Association, the year 1945 has been one of continued expansion and consolidation of its activities. The highly organized efforts of the Association for cooperation with the various war agencies have been supplanted since V-J Day by a constructive program designed to better educate the public and to promote more intelligent use of plastic materials within the industry.

"It is realized that this objective can best be accomplished by close liaison and cooperation with the Society of the Plastics Industry. An increasing percentage of plastic materials, however, is going into widely diversified end products far removed from the plastics industry, so-called. This has introduced new problems and calls for new techniques in their solution.

"Since the Resin Adhesive Manufacturers' Association merged with P.M.M.A., the program originally mapped out by the former association has been resolved and extended until the group, including its technical committees, is recognized as the focal point for industry-wide problems. During the year, they have cooperated with Forest Products Laboratory and others on mutual problems with regard to wood gluing, laminating and assembly. The group is currently working on a uniform classification of resin adhesives and test methods for plywood adhesives. The West Coast technical committee is becoming more unified and active in handling industry problems in that area.

"Not reconversion so much as expansion to meet rapidly growing demand was the big task for most individual material producers. As an industry representative, the Association has translated individual plans into composite figures which will serve to reassure molders, fabricators and ultimate consumers that plastics supplies will be adequate. The results of a survey conducted through the office of Frank H. Carman, general manager of the Association, indicate that producers will spend 102 million dollars to increase plant capacity over the next 2 years and that the overall production of plastics materials will be upped by nearly 300 million pounds per year.

"Through Association efforts in cooperation with other segments of the industry and the Bureau of Census of the Department of Commerce, this agency is now publishing monthly figures on production of plastics. With the Bureau of Standards, a program of standard colors for one type of plastic is now going forward.

"Following a year's survey conducted for the Association by the Massachusetts Institute of Technology, a contract for a long range research program has been signed with the Institute to investigate test methods for plastics. This data will be published as it becomes available.

"The book, "Technical Data on Plastics," was revised in April 1945 to include the newer plastics. The technical committee, in cooperation with several government agencies, assisted in compilation of material specifications, and worked with respective SPI committees on their programs of classification of plastics and informative labeling.

"To serve the industry better, the association will be incorporated as the Plastic Materials Manufacturers' Association, Inc., beginning in 1946. It is believed that past and future activities of the Association warrant this permanent organization to permit more effective operations."

In view of the wide variation in cleaners and in order to maintain our conservative pattern we are arbitrarily allotting 2 lb. of phenolic and 3 oz. of cellulose acetate or cellulose acetate butyrate to the 2,000,000 or more cleaners that should be built in 1946—a total material demand of 4,000,000 lb. of phenolic and 375,000 lb. of cellulose acetate and cellulose acetate butyrate.

Small electric appliances

Although we have no data showing item by item the prewar production of small electric appliances, there are several excellent surveys of the expected output in the first full year of production after the war. The General Electric Co., after study of the various surveys, reported their estimate for small appliances produced in 194x as follows. We have added the listings of the plastic used per unit and expected total consumption. (X represents the first full year of consumption.)

Appliances	*194x units*	*Plastics per unit*	*Approximate total of plastics*
		Oz.	*Lb.*
Toaster	4,100,000	15 to 20	3,700,000 to 5,100,000
Grill	800,000	4 to 6	200,000 to 300,000
Roaster	420,000	14 to 16	360,000 to 420,000
Mixer	1,100,000	8 to 10	550,000 to 680,000
Percolator (metal)	1,100,000	6 to 8	410,000 to 550,000
Coffee maker (glass)	2,260,000	10 to 15	1,410,000 to 2,110,000
Clocks[a]	7,800,000	6 to 14	1,460,000 to 3,410,000
			8,090,000 to 12,670,000

[a] We are estimating the total on the basis of one-half of this number since many cases will be made of other materials.

This estimate of from 8 to 12 million pounds is considered very conservative. And of course there are various items such as waffle irons, sandwich toasters and heating pads, dry shavers and cigarette lighters that are not included here. It would be no surprise if more than 15,000,000 lb. were consumed by small appliances in 1946 and that amount is about 3,000,000 lb. more than the monthly capacity of the phenolic molding powder facilities at the end of the war.

According to Frederick M. Mitchell, former head of WPB's consumer durable goods division, his survey indicated that the small appliance industry expects to be operating at about twice its prewar volume by the middle of June 1946.

Juke boxes, coin machines, vending machines

These machines represent a most interesting field for plastics. The CED survey showed an estimated increase in this industry of 110 percent for 1947 which is greater than the increase for any other industry save only plastics, rayon and transportation.

There are two branches to this budding young field—amusement machines and vending machines. While the latter group prefers to be disassociated from the former, the principal manufacturers of amusement machines[1] are likely to become a major force in the manufacture of vending machines.

Chief users of plastics up to now are the nickel

[1] Wurlitzer, Rockola, Mills, Seeburg, Aereon and Bally.

The big demand for plastics in the radio field is for use in small table models. Before the war, cabinets of this type consumed from 1-4 lb., the majority falling in the 1½ lb. class

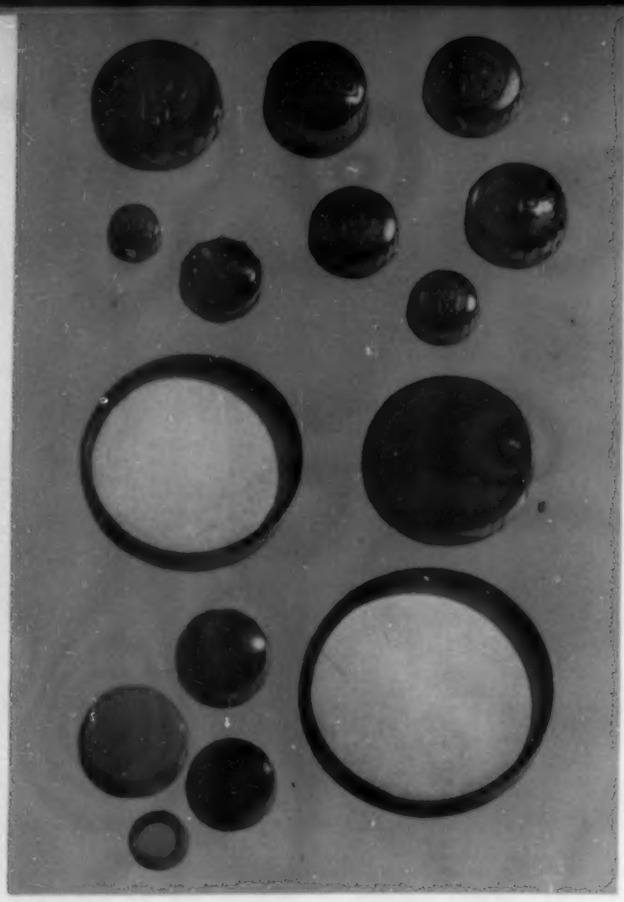
phonographs or juke boxes; the principal plastic used is cast phenolic. Its high color and forming qualities are desirable characteristics for this application.

Other plastics used in minor accessory parts today, perhaps in major elements later on, are polystyrene, cellulose acetate tubing, vinyl resin and laminated parts. Whatever the material, it should be a type that will not scratch nor shrink. And it must lend itself to the music box's requirement of bright colors and resistance to rough-house treatment.

During the war all these manufacturers were heavily engaged in electronics production where they had considerable experience in the different techniques of handling plastics. Today the demand for all types of coin machines is so great that the manufacturers are using any material available which means that, save for juke boxes, only the old type metal box is in production. We are assured, however, that plans now on the drawing board call for the use of quantities of plastics.

Statistics for the industry are startling. A few which were compiled by *Billboard* magazine are presented in Table III shown on the next page. According to the same source 49,000 juke boxes were produced in 1940 and an estimated 39,000 in 1941.

Anywhere from 10 to 15 lb. of plastic is now used in one of these phonographs; more will be used in the future. The 256,000 boxes needed at once would require at least 3,500,000 lb. of plastic. Only a little



Reliable estimates indicate that 20,000,000 lb. of plastics will be needed to meet demand for molded screw caps made in 1946

imagination is needed to see the possible future for plastics in coin machines.

Stoves

Gas stoves—It was estimated by WPB that by June 1946 production of gas stoves will be at the rate of 220,000 a month, well above the average monthly rate of 165,000 for the year, July 1, 1940, to June 30, 1941.

A representative company states that their old model contained the following white urea parts:

	Oz.
Stove handles	12
Gas cock handles	2.5
Stove knobs	0.5
Stove condiment sets	4
Timer dials	1
	20

The company's new model is to contain 28 ounces. In order to follow our conservative trend we multiply the 1940 production of 165,000 stoves by 20 oz. and find that at least 206,000 lb. of urea molding powder should be consumed for gas stoves in 1946.

Electric ranges—Some 600,000 ranges were produced in the base year, 1940 to 1941; a rate of 92,000 a month is expected by June 1946.

One manufacturer reports that about 10 oz. of plastics are required for electric ranges, including urea for fixtures and phenolic or melamine for electrical connections. If the industry produces no more than in 1940 to 1941 it would require at least 375,000 lb. of plastics.

TABLE III—JUKE BOXES, COIN AND VENDING MACHINES

Machines needed	
Pin games	456,000
Phonographs (juke boxes)	256,000
Vending machines	303,000
Slots and consoles	287,000
Number in use Dec. 31, 1941	
Pinball games	250,000
Consoles	200,000
Phonographs	300,000[a]
Cigarette vending	126,500
Beverage vending	28,000
Candy bar vending	250,000

[a] Most of them now obsolete or worn out.

Radios

Probably none of its customers put the "bee" on the plastics industry so much as did radio manufacturers immediately following V-J Day. The reason, of course, was the great rush to be first on the market.

One molder of cabinets said that radio manufacturers had developed a system of expediting which had not been equalled during the war period but that their efforts had been directed mainly toward the procurement of sufficient parts to produce large quantities of samples for use of distributors. He thought that the extreme pressure for radio molds may have been one of the causes for the stringency in the plastic mold industry.

There are many and confusing statistics in the radio industry, but certainly all surveys indicate that the pent-up demand is one of the most dominant of all consumer wants today and approximates 26,000,000. Since most of the plastics used in radios goes into small models, our figures are confined to that category.

In the November MODERN PLASTICS figures from production records of the radio industry indicated that almost 6,000,000 small models were produced in 1941 and that 4,000,000 of them were housed in plastic cabinets. The same authorities estimated that at least 70 percent of the 7,000,000 or 8,000,000 small radios to be produced in 1946 would be in plastic cases. The same article listed many other parts of the new radios aside from cabinets that will be fashioned from plastics.

Different companies use different amounts, and it is only possible to take a mean average. RCA reports that their prewar plastic cabinet required 2 lb. 4 oz.; a new model will weigh twice that. Stewart-Warner states that the average amount of plastics in their model will weigh from $2^1/_2$ to $3^1/_4$ lb., about $^1/_4$ lb. more than the prewar model. However, they are contemplating a smaller set that will bring down the average. A raw materials estimator figures that the weight will run from 1 to 4 lb. with a majority in the $1^1/_2$-lb. class.

If the average is 2 lb., the total amount of plastics needed for the minimum of 5,000,000 small radios to be built in 1946 will be about 10,000,000 pounds.

Flashlight cases

This is an application which proved by its wartime performance that plastics can do a superlative job. Manufacturers are not yet willing to admit that plastics

will completely supersede metal for flashlight cases, but they will concede that it has advantages, particularly that of non-corrosion.

About 2,225,000 cases per month, or 26,700,000 a year, were manufactured in the base period 1940 to 1941 according to WPB's first Reconversion Report on August 25, 1945. At the same time, WPB estimated that 3,600,000 cases per month would be the manufacturing rate by June 1946.

Flashlights are of all sizes and weights, but an average of 2 oz. of thermoplastic material per case is a conservative estimate. At that amount and figuring on at least 26,000,000 cases for 1946, the plastics content would be over 3,200,000 pounds.

Closures

In 1940, plastic caps represented about 18 percent of the total screw and lug caps production. In 1944, plastic caps ran about 20 percent of the total. Major producers believe that in 1946 metal caps will still be produced at a ratio of about $4^1/_2$ or 5 to 1 plastic closure, but the screw cap market has shown substantial growth in the past 2 years as it has tried to keep up with glass production which has doubled in the last 5 years. One of the principal manufacturers estimates that it will require 20,000,000 lb. of plastics to meet the demand for all molded screw caps that will be produced next year.

Buttons

At the last S.P.I. meeting in November 1945, Mr. Neil O. Broderson stated that the plastics button industry had expanded 100 percent since 1939 with a production of 78,000,000 gross in 1944, compared to 39,000,000 gross in 1939. He predicted that in a normal year such as 1947 production may recede to 58,000,000 gross with a value of from $30,000,000 to $35,000,000. He warned that the industry should assume that any additional increase in markets as a result of the replacement of natural materials with plastics will be offset by the invasion of slide fasteners, snap fasteners and elastic waist bands. However, in a more recent statement, Mr. Broderson has stated that 1946 may be a better year than the so-called normal 1947 year.

Cellulosic plastics, exclusive of nitrate

Except for the specific applications mentioned in preceding sections, we are lumping all products produced from cellulose acetate, cellulose acetate butyrate, cellulose propionate and ethyl cellulose because of the near impossibility of breaking them down into various items such as optical goods, combs, electrical goods, bathroom accessories and the like.

At the end of 1945 the demand for material to make items such as those just listed was far from satisfied. A Midwest representative of one of the material producers estimated that his company could supply only one-third of the demand. Edward W. Ward, general sales manager, Plastics Div., Celanese Plastics Corp., said his company could take care of no more than 25 percent of the requests for cellulose acetate molding material in the New York district. He further stated that the nation-wide demand for cellulose acetate sheeting was running about 50 percent ahead of supply.

It has been a tough spot for raw materials producers. Some of their prewar customers who may not have required great quantities during the war are now back demanding the same amount as in peacetime. Customers who were built up during the war can't understand why they must now take cuts of 25 percent or more from their current orders.

One industry statistician has figured that the 1500 or so machines in operation at the end of 1945 could handle 130,000,000 lb. of molding material on a 24-hr.

PHOTO, COURTESY CELANESE PLASTICS CORP.

Eyeglass frames are one of the biggest outlets for cellulose nitrate. Price and color play an important role in the selection of this plastic material for this application

6-day week. He states further that if 1000 machines were added during 1945 and 1946, 120,000,000 lb. more could be processed. With the industry producing at the rate of 65,000,000 lb. a year during 1945, it is apparent that a great deal more raw material is necessary to meet demand.

What is going to be done about it? Frank Carman, general manager, Plastics Materials Manufacturers' Association, who conducted a survey of his members in order to enlighten the industry's customers on expansion possibilities, says that consumers may anticipate a 6 to 10 percent increase in the combined acetate-propionate-butyrate production in the first quarter of 1946. However, 43 percent more will be added in the latter part of 1946 and through July 1947 which means that by midyear of 1947 the industry should be producing more than 8,000,000 lb. of molding material monthly in comparison to somewhere around 5,500,000 or 6,000,000 lb. today.

It seems generally agreed that the industry will be running about 7,500,000 lb. monthly by the end of 1946 but during the earlier months of the year the capacity will be much less. However, it is possible that a total of 75,000,000 lb. may go to market in 1946. If that goal is reached, it will, according to one material producer's estimate, be roughly divided as shown in Table IV above.

The reader will note that there is not now nor will there be in 1946 or 1947 enough of the cellulose ester materials to meet the lowest estimated capacity of the injection presses, namely, 130,000,000 lb., to say nothing of the amount needed by extrusion machines.

These attractive cellulose acetate boxes indicate one of the ways in which plastics can be used by the packaging industry

PHOTO, COURTESY SARA FOX

TABLE IV—POSSIBLE DIVISION OF CELLULOSIC PLASTICS

Class of trade	*Amount*	*Proportion of 75,000,000 goal*
	lb.	*%*
Automotive	11,250,000	15
Miscellaneous industrial	18,000,000	24
Continuous extrusion	11,250,000	15
Novelties	9,750,000	13
Toothbrush handles	6,000,000	8
Combs	4,500,000	6
Telephones	4,500,000	6
Toys	3,000,000	4
Cosmetics	3,000,000	4
Radios	2,250,000	3
Refrigerator parts	1,500,000	2

However, it is presumed that ethyl cellulose, acrylic resin, polystyrene and vinyl molding materials will help to fill in the gap and take up a large portion of the 120,000,000 lb. of machine capacity that will come in during 1946 and 1947.

Ethyl cellulose is being widely used at present for many applications that once were cellulose acetate or cellulose acetate butyrate. Extruders and molders assert that it has definite possibilities for automobile steering wheels, fountain pens, telephone applications, the new wheel disk for automobiles, and many others. However, it is difficult to increase production of this molding powder because the same facilities are required as those running on acetate. Production capacity for flake at the end of the war was at least 800,000 lb. monthly, perhaps more. The Carman survey says availability will be increased 13 percent in the early part of 1946. By the first quarter of 1947 the increase should approximate 36 percent of present supply.

Acrylic molding powder too is in great demand, particularly for extrusion. At the end of the war production was estimated as between 300,000 and 400,000 lb. a month. The Carman survey says production will increase by approximately 20 percent in the first quarter of 1946, some of it coming in during February. An increased quantity of machine-cast acrylic rods of thickness over $1/2$ in. will be available in January.

Cellulose acetate sheet, rod and tube

According to the Carman report producers are running at capacity on sheets, rods and tubes, but shortage of flake is restricting operations. There is no forecast for increased production of *film* during the first quarter of 1946. However, customers can anticipate increased availability of continuous sheeting during the latter part of 1946 and through July 1947, amounting roughly to a 66 percent increase over the present rate. In a November statement, W. Stuart Landes, president of P.M.M.A., stated that 30,000,000 lb. of cellulosics, including ethyl cellulose, were then being manufactured annually in addition to the 60,000,000 lb. for molding materials. Acrylic sheeting is available in any reasonable quantity today according to the producers.

Cellulose nitrate

In the prewar peak year of 1937 the output of cellulose nitrate was 17,800,000 lb. of sheets, rods and

tubes. More than 16,000,000 lb. were produced in 1944 despite a shortage of flake and camphor used as a plasticizer. Today demand is in excess of supply. According to the Carman report flake production is now 50 percent over that of 1944 and a slight increase in capacity is anticipated early in 1947.

One of the most desirable end uses for nitrate is fountain pens. It is expected that the medium- and low-priced pens will remain in nitrate for years to come if for no other reasons than the price differential and machining qualities.

Nitrate for tool handles is another natural that continues to increase in volume despite competition from metal and other plastics. The poundage is sizable in multiple orders with screwdriver handles, for example, requiring from 1 to 4 oz. of material.

Polystyrene

The magic word to many injection molders today is polystyrene. How much and how soon?

Various figures released from time to time indicate that close to 1,700,000 lb. were distributed in the month of September 1945. Probably between 100,000 and 300,000 lb. was being used for adhesives, emulsions, polyfoam and for purposes other than molding. Unofficial reports indicate that as much as 16,000,000 lb. were consumed in 1945.

The speed with which new facilities are obtained will determine how soon more polystyrene can be made available. There are still serious bottlenecks to be broken before equipment can be set up. One of the short items is milling machines and it is possible that some of those machines may be diverted from vinyl to polystyrene.

There is certainly no danger of a styrene monomer shortage. Government officials have stated that, if asked, they would supply monomer provided privately operated facilities were not sufficient to meet demand.

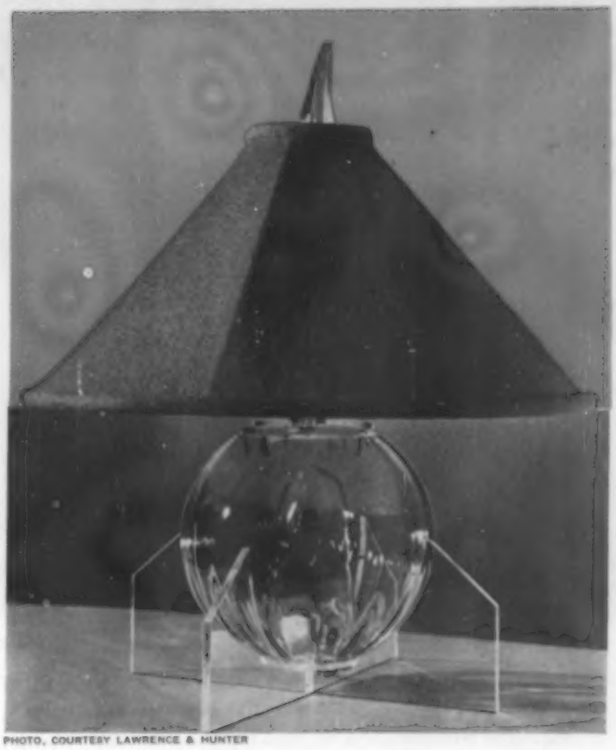
According to the United States Tariff Commission Report on Rubber the styrene plants listed in Table V were in operation during the war.

Just a little over 1 lb. of monomer is required for 1 lb. of polystyrene. It is obvious from Table V that Dow can supply around 2,000,000 lb. of monomer a month from their own plant. Of course, a good percentage of this is now going into rubber, but the volume of production is more than is needed for polystyrene at present. This condition will not exist for long, if present facilities increase as expected.

TABLE V—STYRENE PLANTS IN THE UNITED STATES[a, b]

Type of plant	*Company owning or operating plant*	*Location*	*Rated annual capacity*
			Short tons
Total			200,000
Government	Carbide and Carbon Chemical Corp.	Institute, W. Va.	25,000
	Dow Chemical Co.	Los Angeles, Calif.	25,000
	Dow Chemical Co.	Velasco, Tex.	50,000
	Koppers United Co.	Pittsburgh, Pa.	37,500
	Monsanto Chemical Co.	Texas City, Tex.	50,000
			187,500
Private	Dow Chemical Co.	Midland, Mich.	12,500

[a] Prepared by the U. S. Tariff Commission from data supplied by the Rubber Reserve Company.
[b] A plant in Sarnia, Canada, with a capacity of 10,000 tons a year is not included in the above tabulation.



PHOTO, COURTESY LAWRENCE & HUNTER

Acrylic materials are finding many uses in the lighting field

The point to make here is that polystyrene production should move along at a fairly rapid rate of increase hampered only by lack of processing facilities in the hands of producers. At the present rate of increase and with a probable speed-up in acquisition of new equipment it seems possible that as much as 5,000,000 lb. per month may be the production rate by October 1946. A production of around 8,000,000 lb. monthly in 1947 is believed possible.

Molders should be cautioned not to count on this production until it actually transpires for many things could happen to upset the applecart.

Carman report

The supply situation on all other raw materials as presented in the Carman report is listed herewith, but we have added to his report an estimated production of each raw material during September 1945 so that the reader may have a rough idea of the amount of material involved. This estimated September production is strictly unofficial—it was compiled by comparison of various government figures with information from interviews given by materials producers to members of the MODERN PLASTICS staff.

Phenolic molding materials—Suppliers are still handicapped by shortages of labor, woodflour and cotton

PHOTO, COURTESY BAKELITE CORP.

Shower curtains are but one of the ways in which vinyl resins are being put to use in the home. Unsupported sheeting is appearing as window curtains, wall covering and table clothes

waste for impact materials. A possible strike in steel industry would eventually slow down coking ovens, thus curtailing phenol supply. In November, producers were operating at about 70 percent capacity. If woodflour and labor become available in early 1946, new facilities will allow about a 16 percent increase in material supply, based upon present capacity. A 24 percent increase is anticipated in early 1947.

Estimated production capacity in September 1945 was 12,000,000 pounds.

Urea and melamine molding materials—Manufacturers are now operating in excess of 90 percent of total capacity and the amount of material presently available to molders is approximately 25 percent in excess of that available during 1944. A 25 percent increase over the present rate of production will take effect in April 1946. By early 1947 production should reach a level 80 percent higher than the current rate.

Capacity in September 1945 was estimated at approximately 3,000,000 pounds.

Polyvinyl chloride and copolymer resin—Shortage of labor is holding production of compounding plants at approximately 70 percent of capacity. However, the output is expected to increase about 100 percent over the long term. There is believed to be enough capacity to take care of all potential customers as soon as manpower is available.

Polyvinyl butyral sheet—There is sufficient capacity to meet normal demands.

Vinylidene chloride resins and plastic—It is anticipated that this plastic will be available during the first part of 1946 in quantities about double the 1944 rate. In early 1947, volume will be 450 percent over 1944.

Adhesives, laminating and specialty materials—There has been a marked drop in the demand for urea and melamine resins for adhesives. In some cases, spray-dried urea resins are running at capacity; additional capacity will come into use during first quarter of 1946.

Laminating material availability offers no problem.

Cast phenolics are being produced at capacity for such products as radio cabinets; orders are 2 and 3 months in arrears. A moderate expansion is expected.

Molders

In order to obtain an inkling of how molders, extruders, fabricators and laminators were faring after the cessation of war business and to obtain a view of their production possibilities for 1946, MODERN PLASTICS conducted a mail survey of the industry.

Except in rare instances, processors converted to peacetime production almost immediately after V-J Day. A typical answer to the question on how quickly conversion was consummated is: "On V-J Day we took all war dies out of the presses, put in civilian dies on which we had a large backlog of orders, and kept right on going at the same rate. We considered a 40-hr. week but had to go back to 48 hr. after one week."

Monthly average production for the balance of 1945 after V-J Day as compared to monthly average before V-J Day was estimated by the processors as follows:

Number of processors doing:	
More than 100% of wartime business	10%
About 100% of wartime business	39%
From 75 to 100% of wartime business	21%
From 50 to 75% of wartime business	22%
Less than 50% of wartime business	8%

In comparing their business after V-J Day with the volume done in 1940 to 1941, some 75 percent of those in business before the war asserted that they were doing more in the latter part of 1945 than in 1940, 14 percent reported about the same volume and 11 percent reported less business now than in 1940.

Thirteen percent of those queried reported that they were not in the plastics business in 1940 to 1941.

When asked what products they were producing the answers were as follows:

Products	%
Automotive	35
Refrigerators	31
Home appliances, i.e.,	38
a. Vacuum cleaners	
b. Washing machines	
c. Stoves	
d. Toasters, irons, etc.	
Communications, i.e.,	50
Radio and television,	
Recorders, phones, etc.	
Electrical components	41
Furniture and furnishings	19
Kitchen utensils and gadgets	30
Medical, scientific and dental (equipment and material)	40
Photographic material and equipment	17
Apparel and fashion accessories, i.e., buttons, jewelry, cosmetics, etc.	27
Toys, games and sporting goods	32
Packaging and displays	22
Stationery, including pens and pencils	13
Industrial uses, i.e., adhesives, tools, gears and gages	10

Molders were practically unanimous in declaring that they converted to the same products they were making in the 1940 to 1941 period with only a few new items. When asked about changes in materials, design and production technique only a few answered. Those few asserted they had added new equipment such as high frequency heaters and labor-saving devices in order to keep up with competition. In typical Scribnerian wit, Geo. Scribner replied to the question of why changes were made: "The world is like that."

In answering the question as to when they could take on more business there was a variety of answers that make definite tabulation difficult but there were certain unmistakable trends that were plainly evident.

Injection molders—Between 50 and 60 percent of all injection molders in the East and Midwest reported in October and November of 1945 that they were either full up or could not take on any more business for 6 months or more; between 15 and 20 percent declared that they were committed for from 2 to 5 months. Between 15 and 20 percent more asserted that they could take on new business right away, but this percentage is deceiving since many were small or new companies.

Another group of less than 10 percent refused to make a definite statement because they were uncertain when they could get raw materials, molds or new equipment.

Compression molders—Approximately 40 percent of the compression molders reported that they were either looking for business or expected to be looking in the next 2 months. The letters indicated that compression molders in the Midwest were a bit more open for business than those in the East.

A few more than 10 percent reported that they could not take on business for from 2 to 6 months. Between 25 and 30 percent reported that they could not promise delivery for from 6 months to a year—one reported 14 months. Their reason was generally inability to obtain or prepare molds rather than a surplus of orders.

The remainder of this group was divided between molders who had gone out of war-enforced custom molding back into proprietary molding, expected soon to be operating at capacity, and another group who were non-committal.

Pacific coast—All Pacific Coast molders who reported, except one, said that they were ready to talk business with all who wanted to buy. This situation is not difficult to understand. Many Western molders have come into the business since the war and do not have a great backlog of prewar customers.

Capacity for new business—Attention should be called to the fact that there was some confusion over the phrase "delivery date." Some molders will promise a delivery in 2 months if the mold is available, but not for 4 or 6 months, perhaps, if the mold must be made. This factor causes some overlapping in our percentages; but by and large the percentages mean that a molder has all the business he can handle for the number of months specified in his report.

Several molders were frank to state that they were holding capacity for a job not yet received or that they could often find a way to squeeze in an order for an old customer no matter how busy they were.

There were, of course, complaints on lack of raw material, some of them violent, with assertions that the molder was getting less material than in 1940. But most molders blamed their lack of ability to take on more business largely to manpower and shortage of equipment, particularly molds.

Paragraphs from letters that are typical of the general trend follow:

"Our facilities are sold out to about 80 percent and for a period of 4 to 6 months."

"The earliest date on which we could accept new business is approximately 30 days but acceptance of new business would depend entirely on the type of part involved. Our larger presses and most of our injection capacity are sold out for an indefinite period. Taking mold construction time into consideration, delivery could be started in approximately 4 months."

A Midwest molder says: "We are completely sold out, and at the present rate of pickup on back orders, we will be sold out for the next five years, unless we add additional equipment. In another of our plants, the 4 injection machines will be busy for 8 to 10 months.

"In our compression department, we are only operating about 60 percent, but this 60 percent of equipment is loaded for the next 10 months. At the rate inquiries are coming in, it will not be too long before we will be at least 85 percent to 90 percent loaded. Mold deliveries still range from 8 to 24 weeks depending upon the type."

Another molder, an old timer known to practically every man in the industry and one whose judgment is seldom questioned, advises against the overly optimistic feeling in the industry. He warns:

"We are trying to fill a 4-year demand in 2 or 3 months. Today's demand is built on war income—when spending eases up, men now talking 1,000,000 pieces will talk 100,000. If there is a dearth of facilities why were some of the older plants faced with a diversion

Table tops are but one use for phenolic and urea laminates

PHOTO, COURTESY BAKELITE CORP.

of old molds, from which they expected to enjoy business, to hungry competitors?"

Machines—It is possible that some of the data given above may be off key because many molders are counting on presses that may not be shipped within several weeks or even months of their scheduled delivery.

Machinery manufacturers have indicated that they had 1500 orders for injection machines as of November 1945. They expected to be producing 50 or 60 a month by the end of 1945 and were hopeful of delivering 1000 in the year 1946. That would be a nice increase to the approximately 1600 in operation last September. But there are many obstacles to be overcome, such as material and component shortages, and possible work stoppages in the metal industries.

Molds—Molds are generally referred to as the worst bottlenecks of the present production situation, but there is some information in letters received from mold makers to indicate that mold time is available but molders don't know who has that available mold-making capacity. Also it seems that everyone is impatient to get immediate delivery without realizing that it requires from 6 to 12 weeks to obtain molds even in normal times.

The MODERN PLASTICS survey indicates that the mold-making capacity in the East is tied up considerably more than in the Midwest. In fifteen letters received from Eastern mold makers, there was only one who asserted that he could make delivery in less than 2 months. One reported 3 months; three reported 4 months; seven reported from 5 to 7 months and the others were non-committal. Most of them reported that their time was completely sold for the number of months reported but that in some cases they were continuing to take orders to be delivered in the distant future; or, that they might take care of an old customer in case of unusual circumstances. It was also carefully specified that delivery date depended upon the size and complexity of the mold.

Of 10 Midwest tool makers reporting from areas exclusive of Detroit, only two declared that they were sold out as far as 4 or 6 months in advance for ordinary molds. In Detroit, a personal interview with 6 molders brought forth the revelation that everyone could take on new business and promise delivery in from 1 to 3½ months' time. The reason given was that all had been working on war orders and now had open time.

The situation can perhaps best be described by excerpts from two letters, both typical of the contrasting situation in the East and Midwest:

From the East—"Our delivery promises are approximately 6 months—9 months on some of the larger molds; from 2 to 4 months on simpler molds. One reason why mold deliveries are lengthening is that the molds are becoming increasingly difficult to make. We are doing jobs today that the manufacturer did not think of doing before the war. The molds going into 16-, 22- and 24-oz. machines are really the combination of 2 or 4 of prewar size."

From the Midwest—"We cannot give an accurate picture of our delivery situation because it may change overnight. Although we employ from 45 to 50 toolmakers, our capacity is such that any two or three molders could, in a week's time, change our delivery quotations from 8 to 12 weeks to 14 to 18 weeks. This is not unusual in view of the pent-up demand. We have been quoting 5 to 6 weeks on small molds; 8 to 10 on medium molds and 10 to 14 on large jobs."

Fabricators

Our survey of fabricators indicated that, in general, they are operating at or near capacity, but are willing to take on new orders with delivery promised in from 2 to 6 weeks. Only about 10 percent of those replying to the questionnaire stated that they would delay delivery for more than 2 months. Not one complained about inability to obtain raw materials, although a raw materials supplier has reported that his demand for acetate sheeting and rods was 50 percent more than he could supply at present.

Laminators

The situation for high-pressure laminators seems to be well described in the following letter written by one of the old-timers in the industry.

"We took a good look at our unfilled business after the cancellation period had cleared away, and were surprised to find that we had a pretty good backlog left. We are unbalanced just as we thought we would be. In some departments we are able to offer spot deliveries and in others we are as far back as 10 to 12 weeks.

However, by the time the results of your letter are ready for publication, we will be substantially on a 3 to 4 weeks' basis."

The laminating industry increased its annual prewar volume of about 23,000,000 lb. in 1940 to an estimated volume of more than 80,000,000 lb. in 1944. The increase was accomplished more by changing over to a 3-shift operation from the 1-shift system than by any addition to facilities. However, laminators increased their fabricating operations considerably over former years and sold more finished goods rather than sheets, rods and tubes. They expect to retain most of that business.

A leader in the laminating field is expected to be decorative laminates for table-tops, panels, doors and similar applications. Producers are expecting to at least treble their production of these laminates.

Low pressure and contact laminates—This field is the great unknown for plastics today. It is a tempting field to many inexperienced operators because of the apparent simplicity of operation and the potential volume. However, that simplicity of operation is a misnomer. Mechanical processing is comparatively simple but the successful operators are those who can employ a large staff of capable chemists with the ability to use and control the resins needed in the laminating process. Handling the resin is the key operation in all low-pressure or contact laminating jobs, according to those who are now working on this type of production.

. . . what it needs from the plastics industry

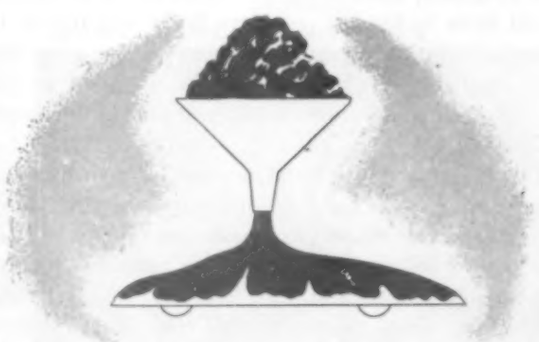
by WILLIAM B. STOUT*

William Stout, design engineer, is now engaged in the development of a new and revolutionary type of automobile for Graham-Paige Motors Corp. which will entail a complete redesign of the fundamentals of motor car construction. While this article appears, on the surface, to be theoretical, it actually depicts the fundamental engineering factors around which Mr. Stout even now is building this new car which promises much of interest to the plastics industry.

IN words of one syllable, what the automobile industry needs from the plastics industry is a plastic from which an automobile can be made.

Present-day plastics are too expensive to fabricate, both from the standpoint of equipment and finesse of detail. Taking either first costs or production costs, no plastic today is suitable for an automobile frame or for its wheels. And this does not take into consideration the limitations imposed by engineering requirements.

If the automobile is to continue in its present form, plastics have no place in it except for decorative detail



and accessory parts. If, at any time, a motorcar is to be made of plastic, it must be *a totally new type of structure designed throughout to take advantage of the new material.*

* Graham-Paige Motors Corp.

Years ago, when we started making the first successful metal airplane in the United States, we had to design a completely new type of plane with a new type of thick wing curve and a new structure inside the wings in order to get a machine in metal that was light enough to compete with the cloth and wood planes of that day. Some experimenters tried to reproduce the cloth and wood plane in metal, but when they got through they had a plane that was so heavy and had

such a drag that it could carry nothing but its own weight. However, by designing a new type of plane, the basis for all modern aircraft was established with weight-lifting characteristics beyond anything dreamed of in the cloth and wood days.

And so in the automobile. If we try to duplicate a steel car in plastic, the task is hopeless since plastic materials as they are known today, lack the characteristics needed for the type of stress encountered in motorcars.

However, if one approached the problem fundamentally, one might arrive at a type of plastic arrangement that could be used for automobiles, provided some firm had the courage, based on knowledge, to start using the new material.

Courage *without* knowledge is fool-hardiness.

(*Please turn to next page*)

Courage *with* knowledge is vision.

We will take it for granted that when we talk of plastics for automobile structures we mean laminates of some material that is held together by a plastic bond. One would not think of making a concrete structure without reinforcing it with an inside structure of steel. Just so, we cannot make a structure of plastic without reinforcing it with some type of fiber structure, or, vice versa, make a structure of fibers without bonding it with plastic.

Much experimental work has been done on laminates. It is my opinion that for motorcar and airplane work the material can contain no moisture. Otherwise, weather and temperatures will affect it adversely. So far, the most promising material for laminates for car structures has been created by the glass industry. Glass fibers have been worked into laminates that have structural strengths that are even greater than those of the highest grade steels.

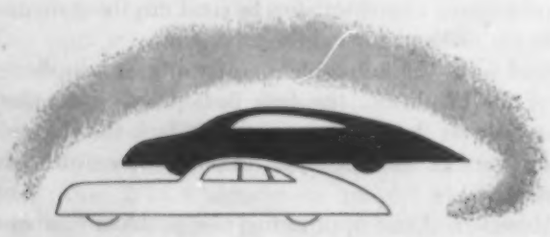
These fibers are available.

The next problem is a plastic which will adhere to glass fibers drawn to a micron or less in diameter and will, at the same time, penetrate between the massed fibers so that there will be a maximum of structural fiber material and a minimum of plastic. This last requirement is necessary from the standpoint of cost, strength and processing.

The problem of developing a car body using plastics as a base, rests equally on the fiber makers and the manufacturers of plastics. Certainly, woven fiber is too expensive to be used in ordinary structures, no matter how great its strength or light its weight. The plastics manufacturer, however, can do a great deal by working with the makers of fibers to produce his material at low enough cost.

It must be taken for granted that the plastic-fiber laminate combination will be more expensive, per pound, than steel or aluminum. But the lighter the material the greater the number of square feet that can be built per pound.

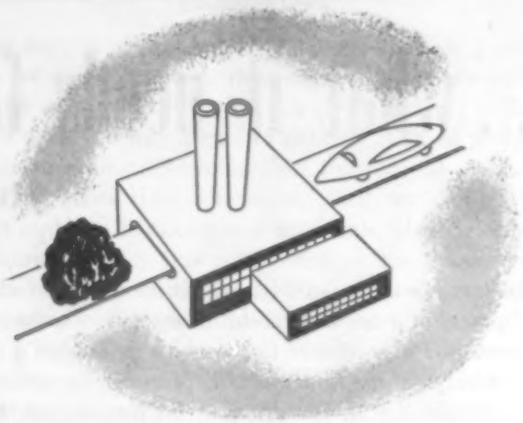
A point to consider is that even if the plastic costs half as much as any present-day material it still would not be low enough in price to be used in any body structure requiring as much labor as do those of present-day motorcars. However I can visualize a possibility



whereby design costs comparable to those of today's automobiles can be had, even in plastic.

If a body can be built with half the weight of the present-day body, then the weight of the chassis can be cut in half. And if, by finesse of design, the engine can make an equal gain, it should be possible to produce, at a price comparable to that of today's Fords, Chevrolets and Chryslers, a man-size luxury automobile with more horsepower per pound than any present-day car, but with a total weight of less than half that of the aforementioned cars.

In an era where labor, as a consumer, must be able to buy the product it makes or suffer as a worker from an inadequate market, some method must be devised of



taking labor cost out of the body—or cutting the labor-cost-per-body in order to increase the number of bodies sold. It is possible to visualize a type of production line where materials of the plastic type flow into one end of a moving production line—parts being fed in from either side—to emerge at the end of the line, after being formed by almost automatic machine, as a completed full-size automobile body.

One goes into a steel sheet mill and sees an ingot go in one end of the building where it is heated once, run through roll after roll, starting slowly and going faster and faster, and emerge, a half a mile away, as a complete and near-perfect sheet steel without its having been touched by a single hand and with only the minimum of watching during the process.

Eventually we may make automobile bodies the same way. This will mean restudy of the automobile body as a structure, since a car produced by such methods would have to have a one-piece body and frame, the wiring, ducts and upholstery being in one structural unit, ready to receive the machinery at either end. *From this standpoint, no motorcar has as yet been really designed.*

In fact, as we understand the word design today, no basic design was ever laid down for the automobile. The automobile started as a horse and buggy. It has grown in detail, but the motor has remained up front in place of the horse.

The use of plastic might well lead to *the first real designing of a complete motorcar*—every item studied for the fundamental purpose it is supposed to serve. If such a car were built, even to the man on the street it would have such visual superiority as to make him cry "I want one." Then a brand new industry will have been born.

For such an approach, the plastic that can be proc-

essed by the simplest means would be the most desirable But at the same time, it should have the most extreme strength and bonding characteristics. It should be impervious to moisture, be weatherproof and permanent. Whether the choice falls to the acrylics, the phenolics, the acetates or the vinyls, will depend on the use to which the plastic is to be put. In my opinion, no plastic now in common use fits motorcar problems.

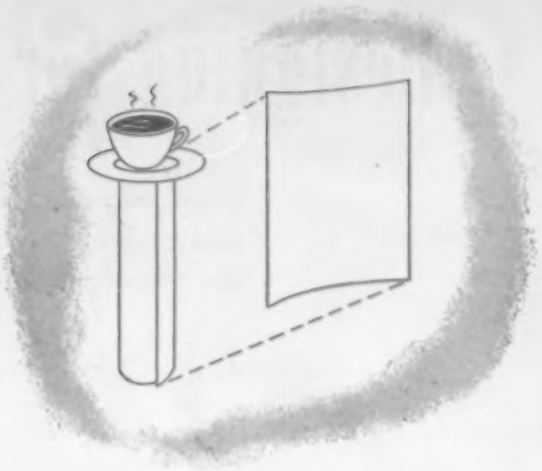
The present automobile maker is not looking for a lighter body, because if he used one there would not be enough weight on the rear wheels of the car to give him sufficient traction. Even today, in the northern states, drivers often put two sacks of sand in the rear of coupes to hold the wheels down on roads.

You cannot have weight and lightness at the same time, of course. But you *can* have strength and lightness. The strength of the structure has little to do with the material used—much to do with how it is used. A piece of ordinary writing paper has little strength if you set it on edge, but the same piece of paper rolled into a tube will hold the weight of a cup and saucer filled with hot coffee.

As for my general thoughts on the use of plastics in automobile accessories:

Steering wheels, accessories, extras, battery parts and so forth, are details of design, each of which requires a separate kind of approach. These small things can be left to the industry.

If, however, a technique can be developed of building automobile bodies from some form of suitable fibers,



bonded with plastic, then the entire plastics industry would need to be at least five times its present size to supply the demand for even one moderate sized automobile company.

Plastic for a car will cost more than an equal weight of steel or aluminum. But if one can devise a car of equal size in plastic and gain real virtues of performance, economy, strength, light weight, longer tire mileage, easier steering, better ride, more room, better ventilation, less noise, less summer heat through the body, less winter cold through the walls, and so on ad infinitum, the cost item would not be so important. In the eventual volume such a car might even be less costly than the heavier car of today.

MINUTE MEN OF CANADA'S 9th VICTORY loan drive, with the slogan "Sign Your Name to Victory," were awarded this pen set. The base is made of several layers of Lucite on top of which is mounted a silver plated copper plate engraved with a miniature replica of the signatures that appear on the European and the Pacific surrender documents. This metal plate is covered with a thin sheet of the methyl methacrylate material. The Parker pen is a copy of the one that was used by Air Chief Marshal Tedder in signing the Berlin document.

PHOTO, COURTESY CANADIAN NAT'L. WAR FINANCE COM.

The base of the holder was laminated and fabricated by Duplate, Canada, Ltd. Finishing and assembling was done by Birks-Ellis-Ryrie, Ltd., who attached the beveled-edged covering plastic sheet by means of invisible silver screws. This company also furnished the standard plastic socket for the pen and attractively housed it in a silver shell.

The Canadian National War Finance Committee ordered about 300 surrender document pen sets and they have proven a great incentive to the selling of bonds. To personalize the award the Committee has the recipient's name engraved on the silver plate which is located at the front of the base. For those who so desire it, the documents have also been printed in French.

Commercial reproduction of the pen set is prohibited and its design is copyrighted by the Canadian government.

Designing for a single material

Good material and design, and the skillful combination of these two basic elements, are the answer to successful plastic applications

IT is not enough that an item, no matter what its nature, be designed for plastics. It must be designed for a particular plastic.

This is the premise upon which one compact manufacturer has built his entire line—the theory that he credits with his success in the high style field.

Gems of perfection

Gems have been described as something prized for their beauty and perfection. When Mavco turned to Plexiglas as the material around which to design its compacts, gems were the goal. Gems in beauty and perfection.

It was for perfection that a single plastic was selected for all these accessories. A designer would be horrified at the thought of producing the same cocktail table design in wood, metal, plastic and in glass. Each of these materials calls for a different construction. And so with plastic compounds, this manufacturer felt. It seemed inconceivable to him that the best properties of a number of synthetic materials could be brought out in a single style compact. Only by concentration upon one plastic could a designer make the most of the good qualities, compensate for the less desirable characteristics.

It was for beauty that an acrylic resin was the choice of Mavco, the reasons leading us back again to gems. The light refraction properties of this plastic and its clear brilliant colors are akin to those of precious stones. Even in the clear transparent compound the material has an unmatched sparkle and clarity.

Gem-cut design

Little wonder, then, that one of the earliest designs to be produced in Plexiglas was the gem-cut compact shown in the four-color illustration on page 112. Fashioned with 16 sides, this case depends entirely upon the rich colors of the acrylic and upon the material's ability to carry light for its beauty and life. No other design could so well express these two principal advantages of acrylic for applications of this type. To make the analogy to precious stones even closer, these compacts are produced in such colors as sapphire, garnet, aquamarine and in the clear crystal.

Like all this company's products, the gem-cut compacts are injection-molded in 4-cavity dies —two complete compacts being produced at each shot. Except for the hinging of the top and bottom halves and the insertion of a mirror and fine mesh powder sifter and puff, there is almost no finishing work to be done on these cases.

Since the first cases came off the line, the fastening device has been modified somewhat in accordance with the habits of women. Originally, no metal parts were used. But women have become so accustomed through the years to the snap action of metal catches that they were slow to acquire the knack of pressing the lid at the very front and back, causing it to flex slightly and free itself

The deep three-dimensional carving of an old sandwich glass sugar bowl was the model for the center panel of this molded acrylic compact. Colored with gold or pastel colors, the circular centers are framed by clear plastic which blends with every costume

COLOR PLATES, COURTESY MAVCO

BAUMAN-GREENE

Old sandwich glass was the inspiration for this molded acrylic compact. The pattern of the central panel is enhanced by the under coating of gold or pastel paint; the clear rim picks up the dominant color of the surroundings—in this case, green. Besides the sandwich pattern shown here, there are a number of other attractive designs

BLUMENFELD

The bright clear coloring and good light refraction of acrylics are used to excellent advantage in this 16-sided gem-cut compact. Like all the other compacts put out by this company, the two parts are molded in a 4-cavity die—two complete units being turned out at one time. This design comes in a wide range of jewel tones

from the fastening molded in the base. The easiest solution was to alter the catch. So, today, all these compacts employ metal fasteners.

Sandwich glass as a pattern

Fashion seems suddenly to have turned back the pages. Both daytime and evening dresses feature accessories that were more familiar in our mother's youth. Hats, too, are faintly reminiscent of the turn of the century.

Fitting in with this style movement are Mavco's old sandwich glass or early American compacts. The advertising catch line reads, "doing something new with something old." And it might just as well have been written "doing something old with something new," so well have the glass patterns been duplicated in the molded acrylic cover.

Again, the excellent light refractory powers of acrylic have been used to advantage. Did not the material catch and pipe the light from one groove of the pattern to another, the entire effect would be lost. As it is, the design has a three-dimensional appearance which belies its being molded into the underside of the lid.

For greater subtlety of coloring, the center of the cover, which carries the sandwich pattern, is painted on the back with various colors. Sometimes gold is used, sometimes pastel pinks and blues, and sometimes the design is left clear. So that the compacts will better complement a variety of colored costumes, the outer edge of the top and the entire bottom half of the cases are left clear. The four-color illustration on page 111 illustrates how well this plan works out. Against a background of green, the clear material takes on that shade. And were the surroundings blue the transparent portions of the case would appear blue.

A familiar complaint of women is the bulkiness of compacts—they take up too much room in a purse, they are clumsy to handle, they are heavy. It would seem that this compact manufacturer has become increasingly aware of this reaction to many compacts now on the market. Every design seems to be a bit thinner than its predecessor, the sandwich glass compact being much flatter than the gem-cut design.

Still, those who prefer large cases have not been overlooked. To please all tastes the sandwich glass design comes in two sizes, one 5 in. in diameter and the other $4^1/_2$ in. in size.

To the public

One factor was left out of the premise that successful plastics applications demand that particular materials be kept in mind throughout the designing. That factor was advertising, selling.

The company has carried on a consistent campaign in the leading fashion magazines tying in its various compact designs with precious jewelry and priceless heirlooms. The illustrations on pages 111 and 112 are typical of the series.

The thought behind this tie-in of gems and compacts is perhaps best explained by citing the reply of one of

MADE OF
Rohm & Haas
PLEXIGLAS
ACRYLIC PLASTIC
"The familiar bomber nose is a Plexiglas nose"
MAYCO NEW YORK
designs exclusively in
PLEXIGLAS
Just as there are many different kinds of wood and metal — so there are many types of plastics. PLEXIGLAS is an acrylic plastic, a type distinguished for its crystal-like clarity, gem tones and lasting beauty. With care, PLEXIGLAS will retain its lively sparkle and holds its shape indefinitely — even after outdoor exposure. The deep rich color Eleanor Hamlin has chosen for her distinctive compacts is part of the plastic and will not chip off.
MAYCO — NEW YORK

A drawing of a transparent bomber nose on the labels that are slipped into each compact emphasizes the clarity and forming properties of the acrylic from which these articles are molded

the country's best-known retailers to a friend who questioned his judgment in lending precious jewelry carried by his store for display with such relatively inexpensive items as molded acrylic compacts. Price is not the criterion of such a joint display, he said. Perfection is. If relatively inexpensive materials are fashioned in a way that makes the best possible use of the qualities inherent in the medium it is just as much a quality item as a skillfully handled gem.

Informative labels

Selling fashion-conscious women on the rightness of plastic compacts does not stop with the intensive advertising campaign. It goes right into the compact itself in the shape of simple, easily read labels. The latest of these four-page cards is shown above.

Appreciating the reputation for performance that was chalked up by acrylic materials during the war, as bomber noses and transparent enclosures of various types, Mavco has tied in this record with the wear that can be expected of these Plexiglas compacts. At the same time these labels do their bit to clear up a much too prevalent conception that all plastics are alike.

Adding up

On the basis of its experience with compacts and cigarette lighters, this company is convinced that there is no substitute for the right plastic. And by *right* is meant a plastic that was carefully selected with a particular application in mind, and a plastic that was carefully worked into a design which met the needs of the user while making the best possible use of the material.

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1 Drink and be merry! These aluminum containers coated with Cordo-clad, a vinyl resin blend, provide a new thrill for the bar enthusiast. Greatest point in their favor is that they transfer no metallic taste as liquid does not come in contact with the metal. The vinyl resin is fired right into the metal and protects the highly polished aluminum from scratching, oxidation and corrosion. The Eliott Manufacturing Co. produces the practical containers for Rubel & Company

2 "Good luck to your heart's best wish," was the thought that motivated the designing of this unique bag. The Lucite frames, in the shapes of a horseshoe, wishbone and heart, distinguish the bags as individual carriers of money, cigarettes and cosmetics. The frames are machine cut from Lucite sheet and then hand finished. The bracelet is also formed from methyl methacrylate. Rynor designed and manufactures the handbag, distributing it through quality stores

3 Little mothers with big ideas about playing house will love this Lumarith doll furniture, complete to the last detail. It is light in weight yet will stand rough handling. Besides, it is lustrous, available in many colors, easy to clean and free from poisonous dyes. Ardee Plastics Co., Inc., does the molding

4 "Let your eyes speak," counsels Helena Rubenstein with an interest-catching eye make-up package featuring two molded containers of eye shadow and eye cream, a tube of mascara and accompanying brush. The small containers are injection molded of clear Styron, Lustron or Bakelite polystyrene by Plastic Molded Arts Co. Serrated edges of the containers act like the facets of a diamond and pick up light. The set is encased in a circular transparent box fabricated from cellulose acetate by Seaman Box Co., Inc.

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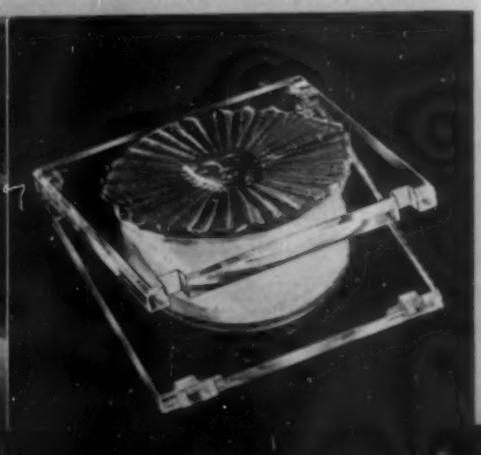

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5 Another step in the evolution of cleaning pots has been taken with the introduction of a plastic scouring cloth. Great, great grandma cleaned pans with a brick; her successors used sand, iron chains, steel wool, etc. The new Plaskon coated pot cleaner's advantages are: it has no metal splints to hurt the hands; it leaves no film; it does not crack or break off, nor does it absorb dirt or food particles. The terry cloth base is sprayed, though not penetrated, with Plaskon resin which forms little beads on the surface to provide the abrasive. The Downy Products Co. manufactures the cloth

6 Lucky lady who can primp and beautify with this Roger and Gallet compact! The simplicity of its lines, the sophistication of design and the delicacy with which the plastic materials are worked, make it worthy of the most discriminating women. The case is molded of Lucite or Plexiglas. Acrylics are also used for the medallion head. In molding the latter, it was found that the female die alone did not bring out details so a female and male die were used. Donmak Creations Co. does the molding

7 Practicing the habit of deception ordinarily leads to no good but here's one case where it does. By pretending to smoke this imitation cigarette, one can break the habit of smoking. It contains a mentholated substance which disconcerts the smoker when he draws on it. Thus, every time he feels the urge to smoke he uses the cigarette like a real one and soon loses the desire to smoke. The cigarette, holder and ash are molded and fabricated of Marblette by Aufhauser Brothers Company

8 This scale of the briny deep is molded from Durez for use in conjunction with a sounding tube to find the depth of the water. Calibrations and instructions are molded right into the front and back of the Fathom rule to assure permanent and accurate markings, then they are wiped with white enamel to facilitate the reading of the figures. The Accurate Molding Corp. molds the scale for Moeller Instrument Co. who distribute it nationally

9 Virtually a "seeing eye," this handy magnifier brings into view much that would otherwise be overlooked. The handle, molded of Tenite II by the Maico Co., Inc. for the Midland Optical Co., has advantages over metal, being lighter in weight, less bendable and breakable, and cheaper in price

PLASTICS IN REVIEW

10 In this package Plaskon and Tenite combine to protect and display precious cargo—a sapphire phonograph needle. The bottom is molded with an external thread and the top with an internal thread so that they can be tightly screwed together. The needle itself is a new development which will reproduce recordings clearly for a lifetime, so long as it is not broken. The case protects the needle during shipping and storing and the transparent top displays it, eliminating unnecessary handling. Norton Laboratories, Inc., does the molding of the case for William Crabb & Company

9

10

Cast plastics for precision optics

1

BETWEEN the magnifying gadget you keep in the top drawer of your desk and the world's largest telescope in the Mount Wilson Observatory there extends a long list of products—cameras, spectacles, telescopes, microscopes, binoculars, military instruments and now television units—which use, as components, lenses, prisms, mirrors and other optical elements having various degrees of precision. Until recently these optical elements, when used where continuity of precision was a factor, were made of glass.

Plastics had long since found a place in optics which did not require the highest precision. Molded cellulose acetate, methyl methacrylate, styrene and polyvinyl acetate have been used in goggles, in the less expensive magnifying goggles and in similar applications. Now, due to research conducted by Polaroid Corporation under a contract with N.D.R.C. calling for the mass production of high-precision optics from plastic materials, a method has been developed for casting plastic optical elements with precise surfaces which require no grinding and with optical qualities never before achieved in plastic.

Official government releases on the development state that in 1940, although American knowledge and skill in optics were of a high order, we were not geared to mass production of precision elements in glass for gunsights, rangefinders, aerial cameras and a host of other military instruments. It was thought that the use of plastics might offer a solution to this problem and, in

2

1—A few of the optical elements that have been successfully cast in plastic. Particularly notable is the large Schmidt reflector in the rear. 2—An assortment of military optical devices fitted with plastic elements

addition, make the design and production of certain instruments easier than was possible with glass.

The scientific requirements were stringent. Two kinds of glass—flint glass and crown glass—used to complement each other optically in optical systems because of their different refraction or light-directing qualities, would have to be replaced by two kinds of plastics which would have these qualities. Then, these plastic optics would have to retain their optical qualities, such as index of refraction, under all conditions of temperature, pressure and humidity; stand up to vibration and shock; be almost perfectly homogeneous; have surfaces accurate to a few wave lengths of light.

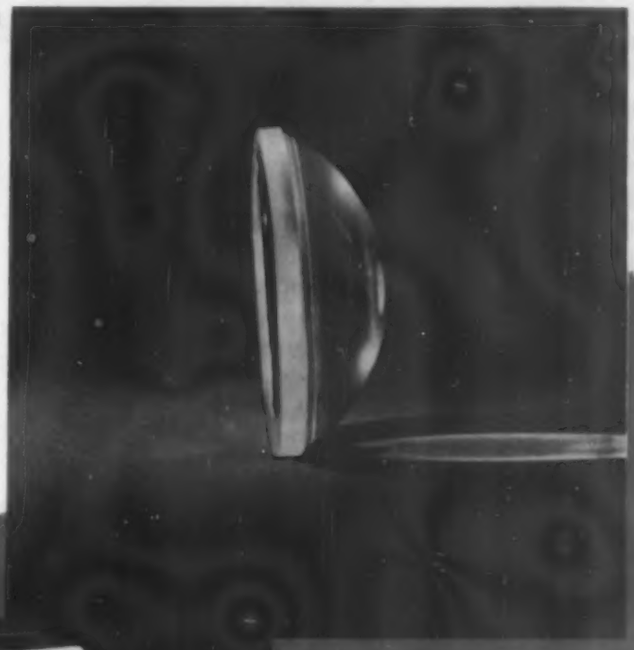
And the production requirements were quite as severe. Operations were to be held to a minimum. The use of simple, easily constructed machinery was obligatory. Labor used in the project was to be semi-skilled or unskilled, drawn from other fields than the optical industry. Grinding and polishing were to be eliminated and boring, machining, tapping and milling done at high speeds without danger of fracture.

If all this could be done, other advantages might accure to the optical industry. Lens designers might find it possible to work out new combinations with optical qualities not available in inorganic glass. High curvatures of lens surfaces might become practicable and economical in manufacture. Certain large instruments, such as binoculars, might be made less unwieldy if their big heavy prisms could be made of lighter weight plastics. Less costly non-spherical or variable curvature surfaces might be possible in plastics, and this would lead to a more general use of wide-angle eyepiece elements and the famous Schmidt system.

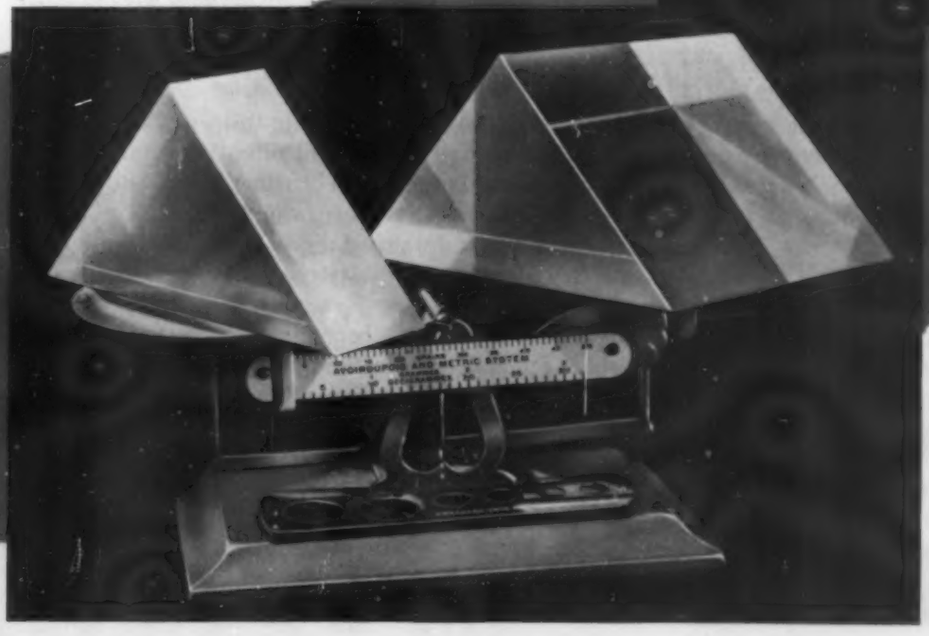
In all, the Polaroid Corporation tested and rated 113 plastic compounds, 17 of which were investigated thoroughly and two of which, polycyclohexyl methacrylate (which has been given the abbreviation CHM) and polystyrene, were found to have the necessary qualities to make them suitable for precision optics. Against a possible perfect score of 100, with 70 points indicating a material worth further investigation, these two were rated as shown in Table I.

CHM is similar to methacrylate but is superior for the purpose in that it has low water absorption, a shrinkage on polymerization of only $12^1/_2$ percent as against 22 percent for methyl methacrylate, and a boiling point of 210° C. as compared with 100° C. Consequently, it can be polymerized at a higher temperature without causing bubbles and can be cast with good homogeneity, although recommended methods for polymerizing it use relatively low temperatures and high concentrations of polymerization catalysts. It manufactures well, but has a low softening temperature of 70° C., is easily scratched and is not tough. Optical

3



4 ALL PHOTOS, COURTESY POLAROID CORP.



3—Optical elements of high curvature are cast in plastic as readily and as economically as elements of low curvature. 4—The larger plastic prism balances a glass prism which is less than one half as big

Table I.—Rating of CHM and Polystyrene

Characteristics	*Perfect*	*CHM*	*Polystyrene*
Homogeneity	15	15	14
Resistance to water absorption	10	9	9
Structural (not surface) hardness	10	8	6
Softening temperature	8	6	6
Toughness	6	3	5
Absence of color	8	8	5
Ultraviolet stability	5	5	3
Ease of polymerization	5	5	3
High monomer boiling point	5	5	3
Low degree of polymerization shrinkage	8	7	6
Degree of polymerization before casting	8	5	8
Ease of monomer manufacture	12	8	11
	100	84	79

qualities are very similar to those of crown glass.

Polystyrene was found to have optical properties quite similar to those of flint glass and, when used with CHM elements in complementing elements in optical systems, provides some qualities not available in most usable glass combinations. It has a shrinkage of 16 percent which means that it suffers some loss of surface accuracy. Also, it is fairly soft and easily scratched.

The manufacturing process is similar for optical elements made from either CHM or polystyrene. The principle is that of polymerization in the mold at moderate temperature and without pressure. In the case of either material, the water-thin monomer is heated with a catalyst until polymerization or thickening starts—special low-temperature catalysts having been developed for this purpose. The partial polymer is then cooled to room temperature and, at a molasses-like consistency, is poured into Pyrex glass molds which are then sealed and baked at 40 to 70° C. for from 5 to 85 hr. depending on the size of the piece. Polymerization is completed during this baking, and shrinkage during the process is taken up either by controlled movement of the lens-mold faces or, in the case of a prism mold, by leaving one surface of the mold free.

Optics are removed from the molds by soaking in warm water. They are then given a stability bake of 5 days at 60° C. to prevent crazing of the surfaces. The optical surfaces, since they faithfully reproduce the precision of the mold-surfaces are never touched. During edge machining, boring, laminating and other finishing processes they are usually handled by vacuum-checking and are temporarily coated with a protective stripping film such as polyvinyl acetate.

Surfaces to be used as mirrors are aluminized by vacuum evaporation, which is standard practice in optical work. Laminating is accomplished by the use of a film which polymerizes at low heat and under very low pressure. Finally, when ready for assembly, the plastic optics are stripped of their protecting films and are given a low reflection coating by means of a spinning process which leaves a film $^1/_{200,000}$ in. thick.

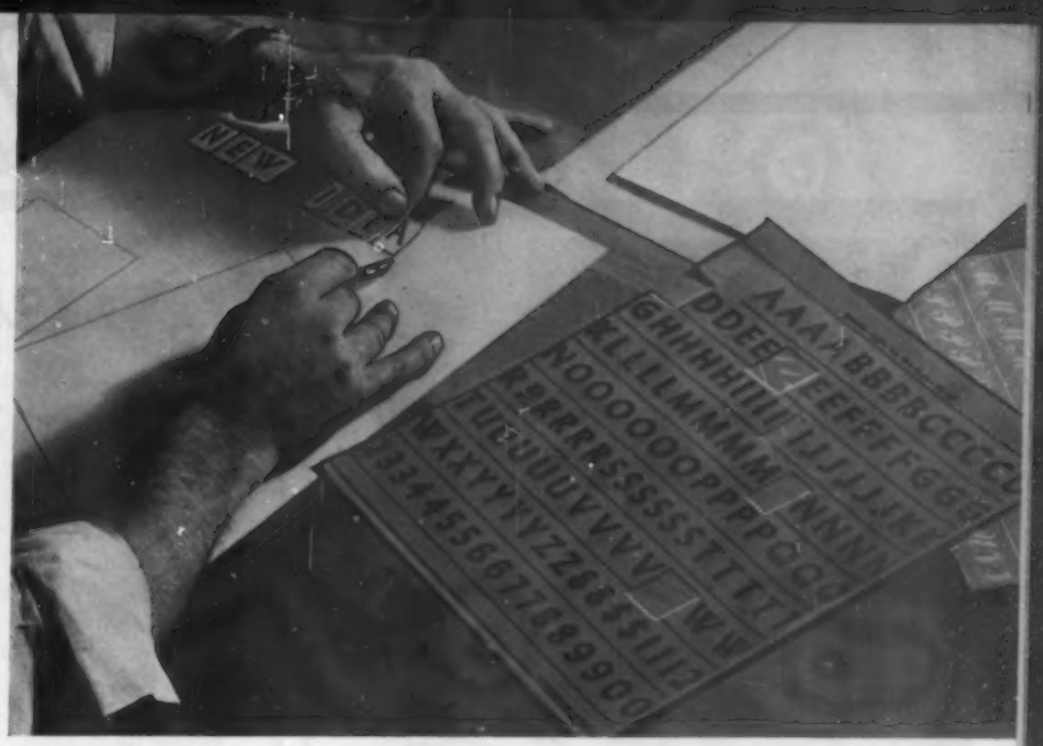
The functional disadvantages inherent in the plastic materials have been overcome in various ways. Sometimes the outside lens in an optical system assembly for military use is made of glass; sometimes a plain flat glass disk is used to protect the plastic elements by sealing up the exposed ends of instruments. In the case of the T108 telescope sight for anti-tank guns, a long flexible rubber eyecup protects the plastic elements as well as the gunners' eyes from the recoil.

Surface softness which makes for ease of scratching and abrasion is one problem Polaroid scientists report as being far from solved, although some progress has been made. Other research bodies are expected to announce results of separate investigations reasonably soon. But for the range of use to which plastic optics are likely to be put, the Polaroid people do not believe this to be a major fault, since satisfactory methods have been worked out for delicate handling in high-speed production.

Plastic precision optics are useful in a range of peacetime products embracing 3-power telescopes and binoculars, medium- and high-quality cameras and lenses and optical systems for television receivers. At present, largely because of shrinkage in the mold these lenses do not have the superior optical qualities needed in 6-power binoculars, high-power microscopes and astronomic telescopes.

The selection of Polaroid Corporation by N.D.R.C. for this piece of work was a natural result of the company's knowledge of light control by means of plastics. Until transparent plastics were put to use in light polarization by Edwin H. Land, founder of the organization, light vibration control was an expensive business accomplished by scarce and expensive crystals and used chiefly in microscopy. Land's first polarizing sheet, which, by its control of light rays vibrating at right angles to the direction of a beam, made possible glare-free photography, aerial observation and automobile driving, was a sheet of cellulose acetate or other plastic. In this a combination of iodine and quinine salt had been dispersed as a colloidal suspension. The sheet was stretched uniformly until all crystals were pointed in the same direction, and, stabilized in its stretched form, was the first mass-produced optical fence, the pickets of which were the crystals of salt. When two such fences are oriented with their pickets at right angles to each other, all light vibration is cut out and light passing through them is reduced almost to zero.

When the war shut off our supplies of quinine, Polaroid researchers developed a new plastic film—polyvinyl acetate, which, when stretched, acquires a molecular arrangement, making it a natural polarizer without benefit of crystal or other addition except iodine. This sheet, laminated to plastics by either solvent lamination process or polymerization of monomeric material, is used today in hundreds of thousands of military and civilian goggles, in camera, periscope and other filter batteries, in the production and viewing of three-dimensional motion pictures and in the famous Vectograph which provides three-dimensional still photography so widely used in aerial reconnaissance during the war and now available to civilian photographers.



Transparent sheets of cellulose acetate printed with 18 fonts of type and coated on the back with an adhesive, simplifies artist's work in transferring lettering to layouts. The user peels the sheet from its paper backing, cuts out the type he needs, presses the adhesive side to the copy and has a ready-made print job

Short cuts with cellulose acetate sheet

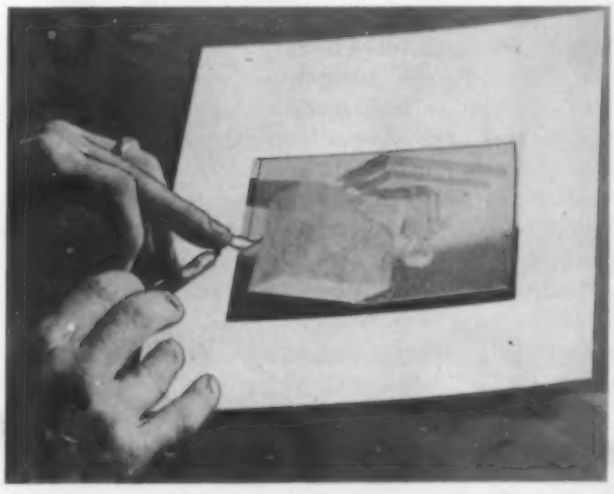
AS a natural corollary to the success of the protective cellulose acetate film used very extensively for military maps and documents, two new products have been developed by Arthur Brown & Bro. based on the same material and principles. Both comprise thin, flexible Lumarith sheets coated on one side with a special pressure-sensitive adhesive and laminated for purposes of storage and handling to thin opaque paper.

The first new product is the E-Z Frisket, a prepared frisket paper for the use of artists and photographic retouchers. The product is very strong, cuts easily, makes sharp hairlines and doesn't curl at the edges. In using it, the artist peels from the paper backing that protects the adhesive the amount of frisket that is needed for the job in hand. He then places the matfinished, transparent film over the drawing or photograph to which it adheres firmly enough for its purpose. His next step is to cut out the portions of the frisket corresponding to the parts of the photograph to be airbrushed, leaving the rest of the picture protected. When the job is finished, the artist simply peels the remaining film from the copy, which is in perfect condition since no cement or residue remains.

The second new product, is Presto-Type, a clear, transparent cellulose acetate sheet on which are printed in black or white a sufficient number of characters in any of 18 popular type fonts. This selection of type enables artists and layout men to "set" their own type for headings in advertising and editorial layouts or in offset printing. Like E-Z Frisket the clear sheeting is coated with a special adhesive which is protected by the paper backing.

The user partially peels off the Presto-Type sheet from its paper backing; cuts out the required letters, including the key line below each line of type; picks them up and places them in final position on the copy to which they adhere quite firmly. After lining up the type, the layout man may cut off the key lines. In setting lettering over photographs, the fonts printed in white are particularly useful.

Cellulose acetate frisket paper has the advantages of being strong, non-curling and easy to cut. The transparent film, coated on the back with adhesive, is placed over parts of a photograph not to be retouched, thus protecting it during the process. When removed, it leaves no trace of cement on the picture



A hobby kit

Building and creating with plastic materials, purely as a hobby, is a new, practical and highly appealing idea which has hit the market in a new form as the Plasti-creator kit. Believing that children rebel against being told why and how to make an item, Plastic Imagineers Sales Co., Inc., distributors, has included in their kit a minimum of instructions. The kit contains extruded cellulose acetate strips, rods and tubes in many colors, some transparent sheet material and five small wheels. A bottle of acetone and a couple of pieces of sandpaper complete the set since kitchen scissors and a small knife are the only tools needed to work these plastic pieces.

The little booklet which comes with the kit establishes in its foreword the principle that the recipient should use his imagination and create his own designs, presenting a few examples of what can be done with ingenuity. A full page is devoted to a short history of plastics, another to a brief general discussion of plastics and another to cellulose acetate, its properties and methods of handling it. Included also are specific instructions for cutting, bending, finishing, polishing and cementing the kit material into several types of fabricated articles.

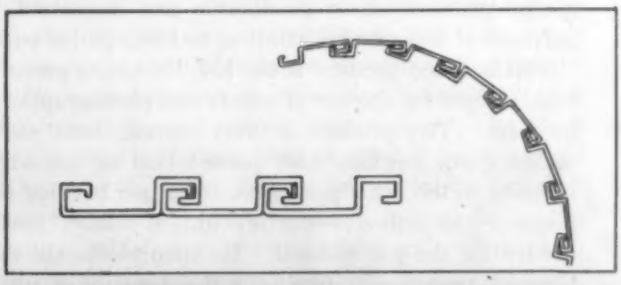
The company's largest kit is pictured here; a smaller plastic hobby set is also available. The plastic parts for both of them are supplied by the R. D. Werner Company, Inc.

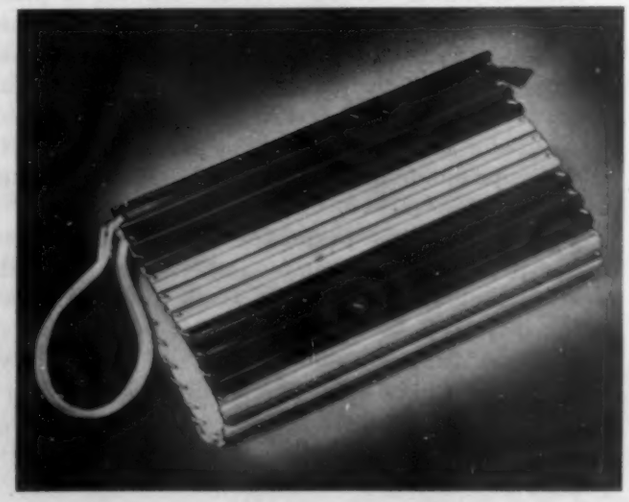
Interlocking strips

Bright horizons are opened for the ingenious plastics designer by the Plasti-Mode interlocking strips (patent pending) extruded of Tenite II or Lumarith. The idea was devised by Plastic Process Co. who furnishes manufacturers with the strips extruded in the shape shown in the drawing. These lock snugly together forming ridges about $^1/_2$ in. wide. In this way a flexible sheet can be formed that will work freely enough to be used like a rolling door, sliding around a radius of $^1/_2$ inch.

In the handbag by Silvercraft Hollywood, Ltd., a sheet is worked into a graceful curve. Side panels of faille are laced to the main body of the bag which has a handle formed from a strip of plastic.

Ordinarily these sheets are made up of strips of a uniform color. However, it is possible to create contrasting or harmonizing effects by alternating colored strips when the sheet is assembled. In a rigid structure the material appears as the base for a lamp. Or the sheets lend themselves readily to use as doors for desks or tables. In the transparent form the interlocked strips may be incorporated into wardrobe trunks or linen closets as doors or covers for individual compartments. Here they keep out dust and allow a view of the contents, yet are practically indestructible.





Products

Bicycle lamp generator

To cyclers who roam country roads or city streets after sundown, head and tail lights with a dependable steady beam are essential for safety and peace of mind. A generator with automatic voltage control to assure a uniform, brilliant light at all speeds above a walk and a satisfactory light at walking speed has been developed by the Make-A-Lite Division of Chefford Master Manufacturing Co., Inc.

The housing, a streamlined unit in keeping with the modern bicycle, is two-toned and a good example of the successful combination of metal and plastics, its functional design following the natural contours of the generator unit. The upper half of the case is of enameled metal; the lower half of black Durez is molded by the Plastics Division of Continental Can Co., Inc. The phenolic provides self-insulation and is durable, offering resistance to oil, grease and the elements.

Dispensing with the need for batteries, the generator provides a steady current which, it is claimed, will not rise above six volts in either circuit regardless of the speed of the bicycle. With separate circuits, not connected in series, for front and rear lamps when one light is damaged, there is no surge of voltage in the other; it continues to shine with the same steady light as before.

By means of a bracket provided, the unit can be quickly and easily mounted on either front or rear fork. Although designed specifically for bicycle lamps, this new generator could well be adapted to other types of equipment.

* Reg., U. S. Patent Office.

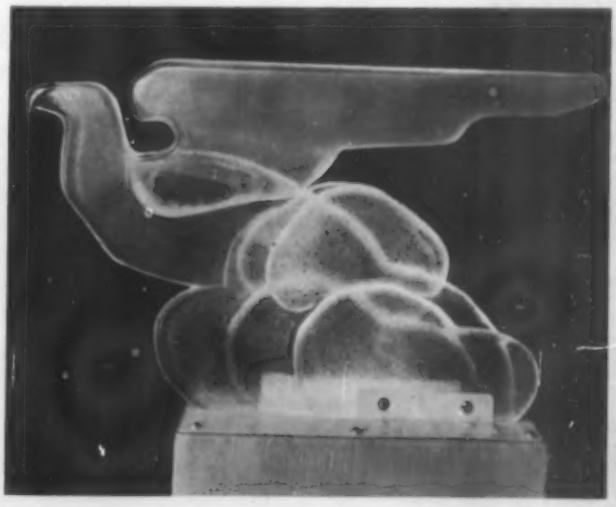
Lighted acrylic carvings

The problem of effective lighting of sculptured pieces is well known to artists working in three dimensions. But it does not exist for Nishan Toor who works in acrylic materials and illuminates pieces with 7-watt bulbs set inside maple or pine bases. Thus the statuary is fully displayed without the benefit of room lighting, a soft glow seeming to emanate from within the carved figure itself.

The effects which Nishan Toor is able to achieve are a tribute to his knowledge of the unique light transmission properties of Plexiglas and Lucite. The fact that light may be carried to an edge, angle or finely etched line allows the sculptor to concentrate light where it is most effective in setting off the all-over beauty of each individual piece. Hence a delicately cut pattern becomes a significant line of light outlining sleeves, hair, eyes or hands and standing out strikingly against severely simple, massive areas of sanded acrylic.

Variations in the lighting effect can be made by different surface treatments of the plastic. Chipping results in a sparkling light, such as that reflected by cut stones; sanding produces a softly diffused light. When the material is given no treatment other than a careful hand polishing, it reacts to light like heavy crystal.

In the stylized model of the eagle, the rocks are carved to give them a textured appearance like that of granite. The statuesque bird has a luminous quality obtained by carving and sanding. Other pieces in the collection include a cascading fountain in which light follows the direction of the curves, creating a feeling of continual movement; a trio of mottled dolphins frolicing over a wave; and a simple carving of a man and woman kneeling in prayer.



Perfecting the details

New and different compacts and cigarette cases are continually appearing on the market to satisfy the whimsical fancies of women. In this case, Bell Plastics Corp. fabricates them from Lucite, Plexiglas and Ameroid sheets and Catalin rods. Perfection of the ultimate product is achieved not only by the careful handling of materials during processing, but through the use of a system of jigs and fixtures, which simplifies machining and assembly, and a patented hinge, developed by George Becker, engineering director, of the firm, which is sunk below the surface of cases and therefore unobtrusive.

The acrylic sheets, from which bodies of the cases are made, are heated to 270° F. in ovens and then punched out into round and oblong shapes or sawed into squares. Automatic turret lathes and drills, operating on indexing fixtures, do all the machining to produce either smooth or frosted finishes. Ashing, wet and dry polishing is done under exhaust outlets to prevent dust from flying about the plant. The metal hinges are merely pressed into position eliminating the necessity of drilling holes. Since metal works on metal in this assembly, there is no wear on the plastic parts.

Color is achieved by dipping, by inserting colored material in back of compact mirrors, by using casein appliques and by hand painting.

The company has eliminated the scrap problem by machining the small cuttings into fancy buttons for sale through other channels.

Electronic control stick

The "most revolutionary advance in the flying of a plane" was the development of the electronic control stick recently demonstrated for the first time by the Air Technical Service Command and Minneapolis-Honeywell Regulator Co. who cooperated in developing it. The housing and cover assembly, directly below the control handle of the new device, is molded of a Durez compound specifically designed for heavy industrial applications where great impact strength is needed.

Combat experience overseas proved that the long missions flown by our heavy bombardment groups were extremely fatiguing to pilots operating our huge four-engined bombers by orthodox methods. So, early in 1943, Minneapolis-Honeywell undertook the development of a device to take over all the effort required in formation flying. The result was the new formation stick, a pistol-gripped-lever about 10 in. long, molded from hard rubber and mounted with an armrest beside the pilot. It is free to move in all directions in the same manner as the "joy" stick of the pursuit aircraft.

Advantages gained from molding the housing for the instrument's "brain" from a phenolic include self-insulation, light weight, immunity to the severe temperature changes and various production economies.

Products

Melamine elbow connection†

Praiseworthy part in the Packard Rolls-Royce airplane engine ignition harness is an elbow connection. This elbow is comprised of two elements—an outside metal shell and a tubular lining of electrical insulating material. Melmac was chosen for the lining because of its ability to w thstand the high temperatures without melting or losing its dielectric strength. It is tested by the molder, the Northern Industrial Chemical Co., for 13,000 volts.

The lining is molded inside the shell and around two mandrels or cores which form the passage through which an insulated wire is finally threaded. The elbow is made on a 120° angle as shown and this necessitates the positioning of two cores at a 120° angle during the molding operation. It is essential that these cores be held securely in position since they must withstand the force of the molding material which tends to force them out of place.

The molding of the lining is done by the transfer molding process in 4-cavity molds in 75-ton hydraulic presses. The melamine is first tableted, then preheated with steam at 150 lb. pressure. It is introduced into the mold cavity at 18,000 p.s.i. The pieces are cured several minutes, then ejected hot.

The gate at the threaded end of the metal shell is annular and the other end is vented to permit escape of air and to allow a limited amount of Melmac to flow through to insure a dense piece without voids. Finishing of the gate and vent ends is done by rotating diamond tools.

A paper tube "shirt" is pressed against the exposed melamine and then the elbows are packed in special egg cartons and shipped to the Rutland Electric Products Co. for mounting in the completed harnesses.

* Reg. U. S. Patent Office.
† Material furnished by Joseph C. Fuller, vice president, Northern Industrial Chemical Co.

A two-purpose watch case

Because the Helbros Watch Co. bases its whole merchandising program on quality of merchandise and originality of design, the standard display and sales package for its wrist watches had to conform to the application of these principles. The answer was found in dark brown grained cellulose acetate used to produce a case which has permanent use as a bedside watch stand, which has good display value on a jeweller's counter and which protects the product from point of manufacture through years of service.

The case, which looks like walnut brown tortoise shell, is molded in four pieces—two to make the inside block for supporting the watch and two to form the outside protective cover. When the two inside pieces are assembled, the union is covered with a strip of velvet. The inside assembly slides back and forth, permitting the outer case to open to display the watch or close to protect it. These two inner parts are notched so that they can slide along tracks which are molded on the inside of the outer case.

Biggest problem in design was to have the case adaptable to use with either men's or ladies' wrist watches. The former could be slipped over the outer cover by stretching the strap to its full capacity. A lady's watch strap, however, could not be stretched to such dimensions. It was necessary therefore to design one side of the cover so that it could be removed but yet would not fit so loosely that it could be easily knocked off. To make this possible, three little dots are molded on the inner surface of the right cover to assure a semi-positive stop while allowing one side to be taken off when ladies' watches are to be inserted. The left cover is put into a die and heat applied to the three inner slide tracks to provide a positive stop for this side of the cover which does not have to be removed at any time. Braun-Crystal Manufacturing Co. molds the case.

With this issue, we are reinstating the Plastics Stock Molds section which was suspended in June 1943 Each month, we will picture and describe molded parts which are available from stock without mold cost, fabricated products and proprietary items. Additional information, manufacturer's names and addresses may be obtained without charge from the Readers' Service Department. Address all inquiries to Stock Mold Div., Modern Plastics, 122 E. 42nd Street, New York 17, N. Y., giving item and sheet number. Items 1–1582, which have appeared previously, are correlated in the Plastics Stock Mold Catalog, available for $5.

Plastics Stock Molds*

SHEET ONE HUNDRED THIRTY-THREE

Utilitarian items such as soap dishes, hooks, plumbing fixtures, etc., available in assorted colors, are suitable for home, factory and office.

1583. Large size soap dish: 6 in. long, 3 in. wide, 1 in. deep. Can be fastened to wall

1584. Toilet float ball: 6 1/2 in. in diameter, overall length, 5 inches

1585. Soap dish holder: 4 1/2 in. long, 3 1/2 in. wide, 1 in. deep. Can be fastened to wall

1586. Pinwheel-type tie rack. Has 16 rods and wall bracket

1587. Removable soap dish: 4 3/4 in. long, 3 5/8 in. wide, 1/2 in. deep. Legs are molded into base

1588. Non-slip wall hook has snap-type catch. Available in a variety of colors

1589. Faucet spray with rubber insert. Available in two sizes: No. 1, for faucets with plain bib; No. 2, for faucets with knurled, beaded or flare bib

1590. Cross-type faucet handles: 3 in. in diameter with metal inserts

1591. Cold water valve made in 2 parts: overall length 2 1/2 inches. Threaded ends: 1 in. in diameter with 1/2 in. inside diameter

1592. Lever-type faucet handles: 2 1/2 in. long, 5/8 in. wide, with metal inserts 7/16 in. opening. Overall length 2 1/2 inches

* Reg., U. S. Patent Office.

A year in plastics engineering

Despite the drain put upon the research and development laboratories by the demands of war, a number of machines and processes were developed which promise much for the future

FROM the inception of the plastics industry up until December 7, 1941, equipment design and molding process development showed a continuously rising curve, and with this expansion and improvement in methods and machinery came a greatly increased molding capacity. However, from the moment the Japanese attacked us at Pearl Harbor, this rising trend flattened off and the industry went through the war period with few advances being made in new types of equipment and new methods of molding.

The manufacturers of molding machinery were tied with what was probably one of the tightest sets of wartime controls laid down for any one group. These controls absolutely prohibited the manufacture of any type of plastic molding or fabricating equipment without the express approval of the War Production Board—approval which was only forthcoming if the company requesting this equipment could prove it was essential for wartime production.

Not only did these controls stop most new development work, but they cut to a trickle the production of the standard types of plastic molding and fabricating equipment on the market at the outbreak of war. This, in turn, put a stop to many advances in the plastic molding art, and restricted the molding and fabricating capacity of the industry.

However, during the latter part of 1944 and the first part of 1945, our war economy was proceeding in high gear. This left the regular personnel with but little time for development work. As soon as this fact became apparent, most companies either set up small experimental and development laboratories or discussed and roughed out possible postwar refinements for their equipment. Directly following V-E Day this tiny effort was greatly enlarged and, with the approval of WPB, all companies were permitted to redirect a certain percentage of their productive and development effort toward new postwar business. Complete descriptions of all this equipment have appeared on the pages of MODERN PLASTICS. In this review we shall attempt to touch upon those machinery and processing developments which promise to contribute the most to the plastics industry.

* Reg. U. S. Patent Office.

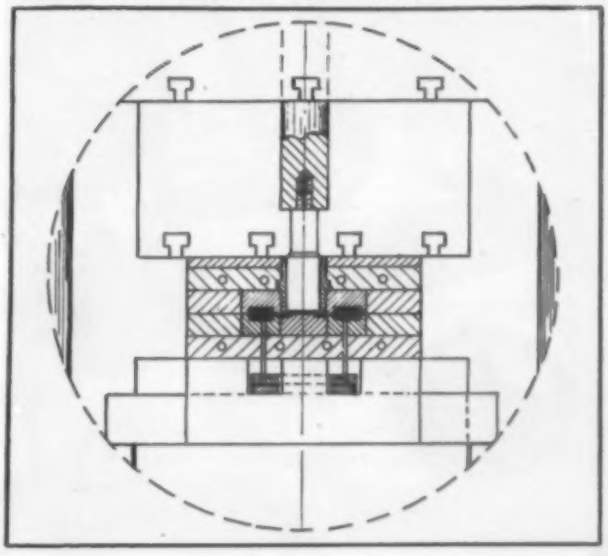
"Hy-Speed" plunger molding

The advantages to be gained by combining high-frequency preheating, a pressure-type transfer mold and a hydraulic press with an auxiliary downward acting plunger, caught the attention of the plastics industry early in 1945.[1] While this press design was not new, the results obtained were startling, made the more vivid by actual comparison of parts molded by compression methods and in the new manner.

Figure 1 is a drawing of this press with a 2-cavity blank mold already installed. The overhead plunger or injection ram is so designed that preforms can be loaded into an open pot incorporated in the top plate

[1] "Hy-speed plunger molding," MODERN PLASTICS 22, 125–129 (Feb. 1945)

DRAWING, COURTESY HEMCO PLASTICS DIV., BRYANT ELECTRIC CO.

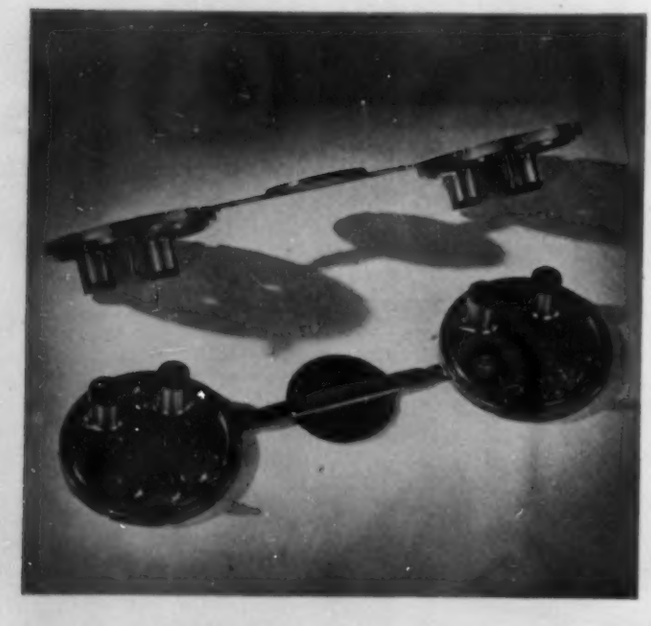


1—This section view of "hy-speed" plunger molding press, which combines high-frequency preheating, pressure-type transfer mold and hydraulic press with an auxiliary downward acting plunger, shows a two-cavity mold installed

of the mold. The first step in this process is the placing of preforms of thermosetting material between the electrodes of a high-frequency oscillator. After the preforms have been thus softened, they are loaded into the pot, the mold being in the closed position. With the mold clamped by the lower upward acting ram, hydraulic pressure is permitted to operate the top ram, starting it moving downward. This action forces the plastic material to the bottom of the pot where it impinges upon a pressure pad in the lower half of the mold which deflects the material at right angles along the two or more runners through the gates and into the cavities themselves. This motion continues until all the material with the exception of a thin cull is forced out of the pot; and the cavities, runners, etc., are completely filled.

In actual operation, this entire process is over in a matter of a very few seconds inasmuch as there is no dwell by the transfer plunger. Dwell is usually necessary if the right amount of heat is to be transferred from the walls of the pot to the preforms so that they will soften sufficiently to flow.

The entire operation is carried out with high pressures in the pot and runners, made possible by the fact that all the molds constructed by Hemco Plastics Div. of Bryant Electric Co. for this molding method were designed with gates approximating 0.015 in. in thickness. These very thin orifices between the runners and the cavity act as pressure-reducing valves. It is said that the rapidity with which the plastic is forced through these small openings causes a marked rise in the temperature of the material—a fact that is thought to be largely responsible for a greatly reduced curing time, even less than the curing cycles which have been so widely publicized for other types of molding that make use of high-frequency preheating.



2—Until a two-cavity pressure-type transfer mold was built for the molding of these meter box covers, the 0.055 in. diameter pins proved troublesome. The difficulty was so great that pins were eliminated and jigs used instead to make the holes

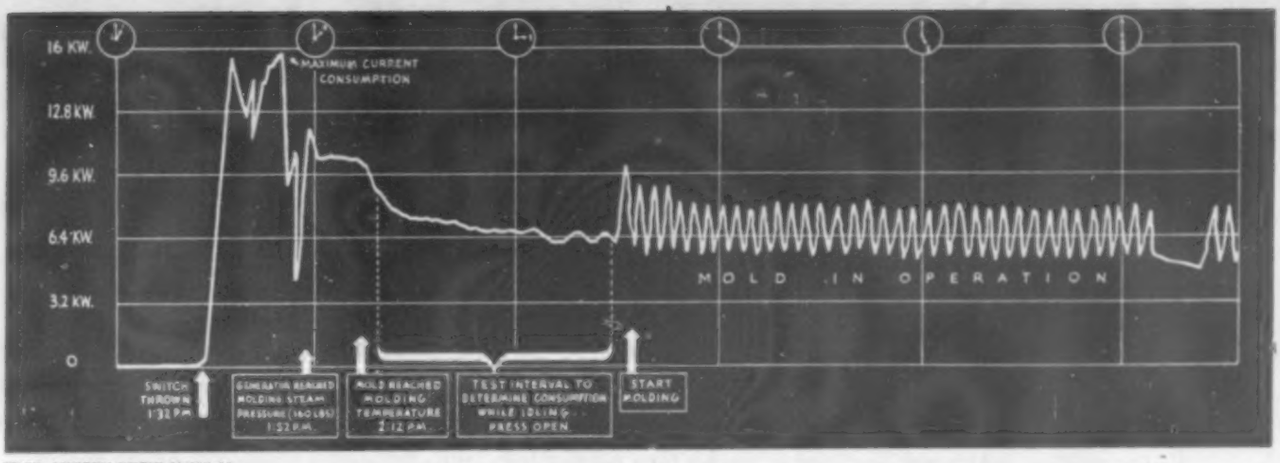
This statement of cause and effect may be open to some disagreement. In jet molding, the theory has been that partially softened material is squirted through a heated nozzle and during its passage through this nozzle, picks up sufficient heat so that the length of cure necessary in the heated mold is much reduced. Another method somewhat akin to jet molding employs a plate that is heated to a cherry red. Material is squirted through a nozzle against this hot plate, the injection pressure then carrying it through to the mold. The theory in both of these cases is the same—that the brief contact of the plastic with a very hot piece of metal transfers sufficient heat to the plastic material to almost completely polymerize it before it gets as far as the mold

In contrast, the theory propounded for the hy-speed plunger method is that the terrifically high friction created on the material as it is forced through the tiny 0.015-in. orifice or gate almost completely polymerizes the plastic before it gets to the mold. An engineer of the molding company has stated that cures as low as 5 sec. have given a completely satisfactory commercial production on phenolic parts with wall sections as thick as $^1/_4$ in., no blistering having been observed in any instance.

Another factor which tends to prove the theory that the temperature rise occurs as the material passes through the gate, is that the preforms are heated for only 15 sec. to a temperature of but 275° F. before they are loaded into the transfer pot. This compares with temperatures of from 325 to 350° F. which are common in other types of transfer molds or in cases where high-frequency preheating is used as an adjunct to compression molding.

Some jobs which had been run previously by compression molding and were then switched to this method clearly indicate some of its advantages. Take, for example, a meter box cover (Fig. 2) which had been turned out in a 9-cavity compression mold. Great difficulty was experienced with 0.055-in. diameter pins used to mold the holes through the covers. Pin breaking became so troublesome that the molder finally eliminated the pins and set up a jig drilling operation for producing these holes. However, when this job was changed over to a 2-cavity pressure-type transfer mold, it was possible to replace the pins and mold the holes through with no pin breakage difficulties.

Produced by compression in a 9-cavity mold, the total cycle for this meter box was 5.42 min. of which 3 min. was cure time and 2.42 min. was open or bench time. When the job was changed over, a 2-cavity mold was built and the total cycle consumed 46 sec., 15 of which were necessary for the cure. The molder states that this reduction in molding time has made possible a reduction of 20 dollars per thousand in the selling price of the covers. A comparison of the specific gravity, cure time and water absorption of the electrical receptacle with $^1/_8$-in. wall section mentioned previ-



GRAPH, COURTESY BOSTON EDISON CO.

3—A recording watt-hour meter made this record of power consumption while installed in the power line of one of the steam generators which were developed for use on individual molding presses as economical power sources

ously, shows the following figures when molded by the two methods:

	Cure	*Resulting specific gravity*	*Water absorption*
			percent
Compression molding	1¾ min.	1.330	0.78
"Hy-speed" plunger molding	10 sec.	1.384	0.27

From the foregoing, it would appear that this method of molding, if properly carried out, will effect very marked savings in production costs and, at the same time, reduce the original mold costs. In addition, the company estimates a 12 percent material saving as compared with any similar type of molding. Inasmuch as the pressures in the molds themselves are greatly reduced, savings in mold maintenance should approximate 30 percent These low pressures would seem to indicate the possibility of cast molds being used, possibly even molds of beryllium copper for short runs.

Steam generator for individual presses

In March, a steam generator for individual presses was announced, together with the results of actual operating tests.[2] This unit consists basically of two electrodes immersed in water that is made to boil by the passage of electrical current. It has no coils or heating elements which might burn out. The inventor, Mr. Vickery, worked out a simple method of controlling the steam pressure without a thermostat, switch or other similar device.

The generator is composed of three separate electrode chambers so connected that water between the electrodes acts as a resistance element and boils as the current passes through it. The rate of steam generation is automatically determined by the requirements of the load. As the desired steam pressure is reached, steam (a non-conductor) gradually replaces the water between the electrodes. This reduces the electric current consumption to the exact amount necessary to maintain the desired steam pressure. The pressure then remains constant but the electric current consumption fluctuates as the demand varies. This Vaportron self-regulating steam generator needs only a water supply and a standard source of electric power for operation.

Many new developments and refinements have been incorporated in this generator for the purpose of making it foolproof, but even the experimental models were economical, witness the results obtained in an actual production test of one of the original units. Figure 3 presents an actual record of power consumption made by the watt-hour meter installed to record the power needed in the operation of this unit. The steam generator was set up for test by the Northern Industrial Chemical Co. and the press was operated in production for over three hours. The chart not only records the power used during this production run, but also the amount of power necessary to heat the mold to the temperature required for molding.

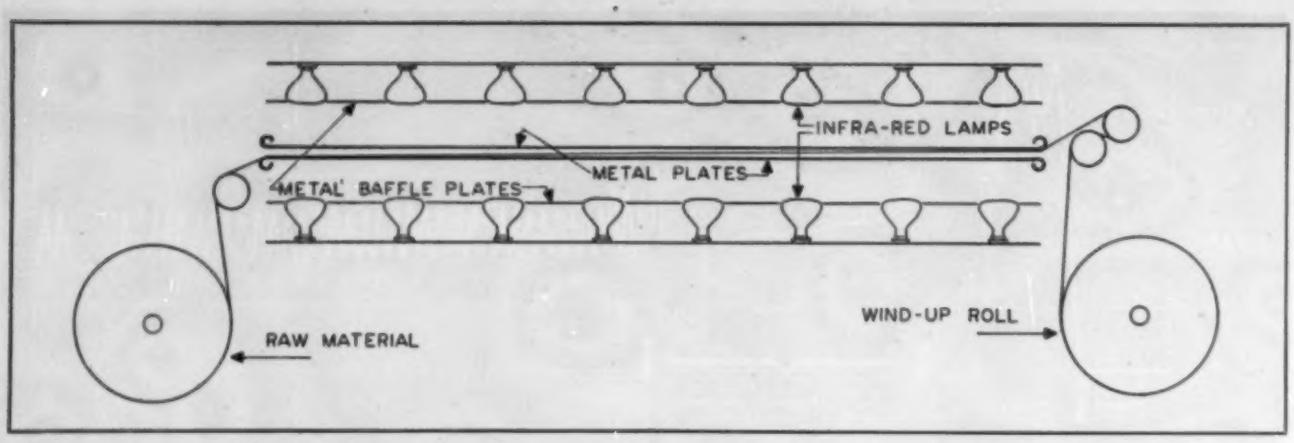
Due to the restrictions which existed throughout the war period, this steam generator was not generally available until the latter part of 1945. However, the A.A.A. Manufacturing Co. now has these units available for immediate shipment.

The pyrolizer and its development

Up until a very few years ago, specifications for standard electrical panel board equipment aboard ship called for phenolic impregnated duck laminate. This material, while performing satisfactorily under normal conditions, was the seat of an ever present fire hazard. Due to the high temperatures caused by sustained high-speed runs, this old style panel board would suddenly burst into flames and give off highly toxic fumes. During 1942, the Navy in cooperation with several laminators developed a material comprising glass fibers and melamine resin which gave promise of being sufficiently fire- and arc-resistant to completely eliminate such difficulties.

This material, however, had in its early form one drawback—namely, lack of strength between the plies

[2] "Steam generators for individual presses," MODERN PLASTICS 22, 133–135 (March 1945).



4—The pyrolizer, which was developed to remove from finished cloth all traces of the lubricant employed in the spinning and weaving of glass fibers, consists of two banks of 125 watt infrared bulbs separated by a $1^1/_4$-in. space

which resulted in delamination. This problem was eventually traced to the lubricant employed in the process of spinning and weaving the Fiberglas fabric. All types of solvents were investigated and found wanting. Finally, a decision was made to remove this lubricant completely by burning, a decision which made necessary the development of a machine that would operate on a mass production scale.[3]

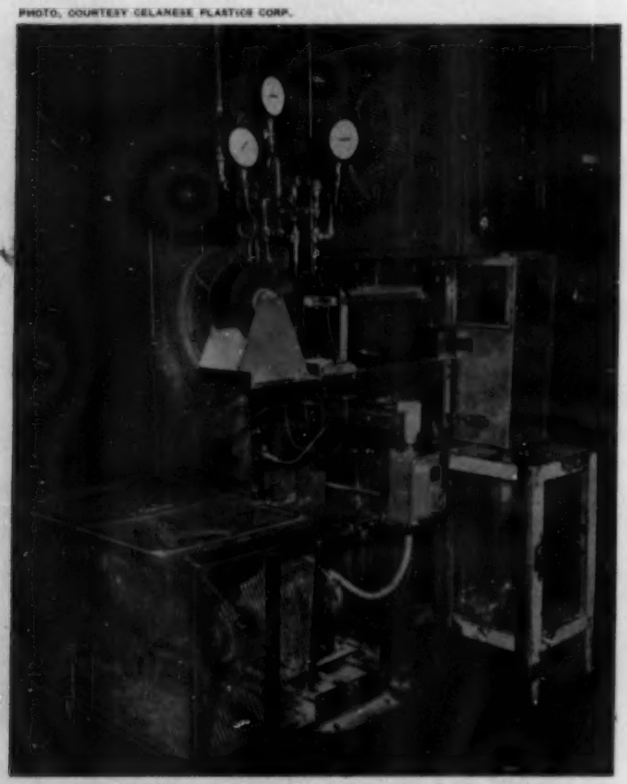
As finally designed and placed in production, this unit—named a pyrolizer—consisted of two banks of 125-watt infrared bulbs. One bank of 170 bulbs is set above a $4^1/_2$-ft. wide by 10-ft. long metal sheet which forms the top of a slot. The other bank, with the same number of bulbs, is set below a similar metal sheet which forms the bottom of this slot. The space between the metal sheets is $1^1/_4$ in. (Fig. 4). The glass fiber fabric passes through the $4^1/_2$-ft. wide slot at a rate of 20 ft. per min. and is subjected to a temperature in excess of 400° C.

Upon entering the slot, the fabric is in contact with the front edge of the lower metal sheets; when passing out of the slot, it is in contact with the rear edge of the upper sheet. Thus, the cloth itself shuts off all draft. This absence of draft in the space between the metal sheets results in a higher temperature and more even distribution of heat than would otherwise be the case. This high temperature does not impair the strength of the glass fabric but does burn off practically all of the lubricant. This makes possible virtually complete coverage of all the glass fibers with resin at the time of impregnation. Actually, 0.4 of 1 percent of carmelized lubricant is left upon the fabric. This residue gives the treated glass fabric a copper color and is said to secure an additional adhesion between the glass fibers and the melamine resin.

While this machine was developed for the war effort, it is now available to all laminators and is used in the treatment of all the glass fiber fabric intended for use in melamine laminates for electrical applications.

[3] D. J. O'Connor, Jr., "Pyrolizer solves bonding problem," MODERN PLASTICS 22, 138–139 (May 1945).

PHOTO, COURTESY CELANESE PLASTICS CORP.



5—Drawn plastic containers can be produced four times faster on this fully automatic high-speed forming press than by the best semi-automatic methods presently in use

A fully hydraulic tableting machine

The problem of preforming also came in for a share of attention with the development by the Watson-Stillman Co. of a fully hydraulic tableting machine capable of producing twelve 1-lb. or ten 2-lb. preforms per minute[4] (Fig. 6). The machine will take dies up to 5 in. in diameter with a maximum fill of 4 inches. This volume of compressed general purpose plastics material weighs 2 pounds. If adjustment is made in the filling slide, the machine will also handle semi-impact materials at approximately the same rate as general purpose materials.

The unit operates under 2000 lb. pressure. With a

[4] "A fully hydraulic tablet machine," MODERN PLASTICS 22, 180 (June 1945).

pump capacity of 23.4 gal. per min., the main cylinder can advance as fast as 770 in. per min. and give a high-pressure preform speed of 52 in. per minute. The ram will return to the open position at a rate of 630 in. per minute. This press can be operated manually, automatically or semi-automatically.

Since this machine is fully hydraulic, accurate setups are not needed to insure adequate pressure on the preform. The depth of fill can be regulated while the machine is in operation. This is accomplished by unlocking the lock nut and adjusting the depth of fill by turning a large hand wheel which is readily accessible from the front of the machine.

Drawn containers

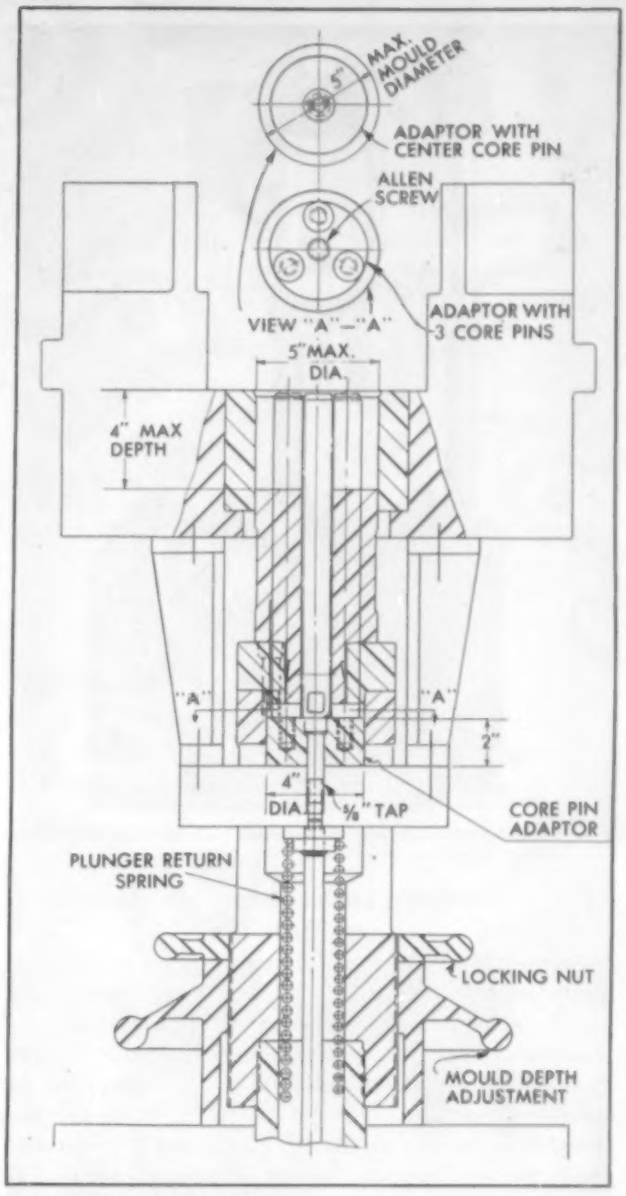
In the drawn container field, also, there were new developments—for example, the Celanese Plastics Corp.'s fully automatic unit for the production of transparent plastic containers by the drawing method.[5] At present, the top speed of this machine has been rated at a maximum of 90 pieces per minute. Machines of the size now in use (Fig. 5) will draw containers up to $3\frac{1}{2}$ in. in diameter with a draw ratio of 1 to 1. However, packages with diameters up to 12 in. are said to be entirely feasible, needing only a larger machine of the same design. It is expected that the draw ratio also will be considerably increased in later models.

In operation, the material is fed from a roll with a standard Hitch feed which is used on many semi-automatic machines. As for heating, a preheater plate provides any necessary preheating temperature, and the design of the dies and hold-down plates is such that they, too, can be heated to any desired temperature. As the belt of material enters the dies, it is sprinkled with a little zinc stearate powder which acts as a lubricant. The drawing stroke is made rapidly and the drawn pieces cut off at the end of the draw. All operations are automatic. As the die is opened, the drawn part passes through a cooling box where a blast of air from a port in the male die hits the part and loosens it; then, another air blast hits the part from the side and blows it into a collecting hopper. The operator has nothing to do except change the feed rolls, collect the pieces and clear any jams that may occur.

Three laboratory injection units

September and October saw the introduction of three laboratory machines for the injection of thermoplastic materials. One, developed by the Watson-Stillman Co., has a rated capacity of 1 oz. (Fig. 7). Completely self contained as far as hydraulic pressure is concerned this manually operated machine is well adapted to short run production and laboratory use. Not only does the single hydraulic ram supply the injection pressure but, through a unique departure from normal mold clamping methods, it also provides the force that is needed to keep the mold halves tightly closed during the injection cycle. A novel hand-operated material loading hopper is so designed that after each shot an equal amount of material is placed in the heating cylinder by the simple expedient of manually shifting a lever forward and back through an arc of approximately 30°.

[5] "Automatic forming machine," MODERN PLASTICS 22, 182 (June 1945).

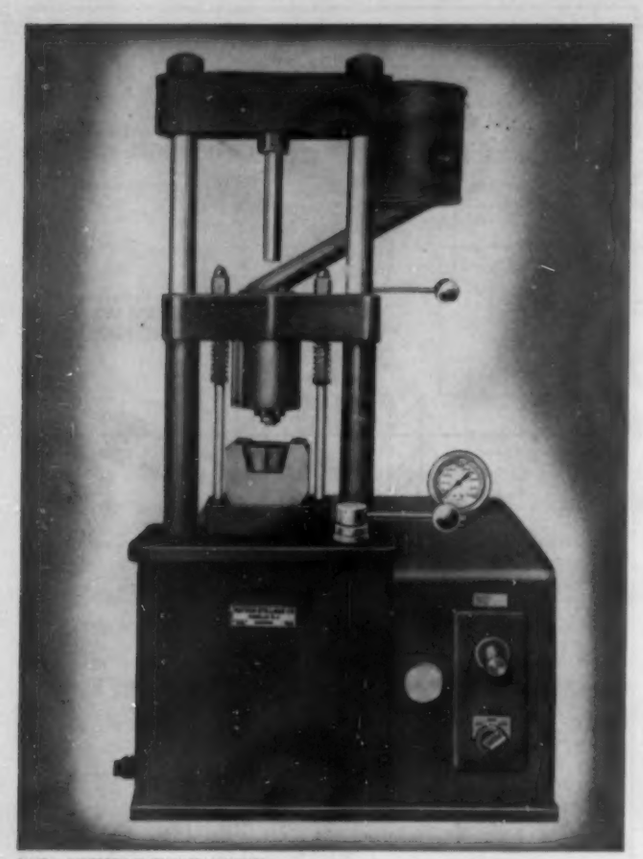


DRAWING, COURTESY WATSON-STILLMAN CO.

6—This fully hydraulic tablet machine is capable of producing 12 one-pound or 10 two-pound preforms per minute

The capacity of the second small injection press to appear in the Fall of 1945 is rated by its suppliers, the Van Dorn Iron Works Co., at up to three-fourths of an ounce (Fig. 9). All power for the operation of this machine is supplied manually; the power for the plunger being supplied by a large hand wheel which transmits a rotary motion to a reciprocating motion through a rack and pinion system. A feature of the equipment is a toggle mechanism which is used to open and close the mold quickly and clamp it rigidly during injection. The machine has a clear platen area measuring 8 by 8 in. and a mold opening which measures 4 inches.

The third machine, brought out by the Sav-Way



PHOTO, COURTESY WATSON-STILLMAN CO.

7—A 1-oz. laboratory unit for injection of thermoplastics

Industries, has a rated capacity of 1 to 2 oz. for thermoplastic materials (Fig. 8). It is a streamlined, completely enclosed model with electronic temperature control, pressure gage and self-contained hydraulic system as standard equipment and an indicating pyrometer as special equipment. The material is fed to the heating chamber from a hopper by a manually operated plunger-type feeding device. One hydraulic ram furnishes injection pressures up to 30,000 p.s.i. and sufficient force for clamping purposes. This clamping is accomplished by virtue of a wedge-shaped mold that mates with a wedge-shaped mold support. The lower platen area measures 10 by 10 in.; the machine occupies 29 by 30 in. of floor space, is $6\frac{1}{2}$ ft. high and has a gross weight of 1200 pounds.

A fully automatic compression molding machine

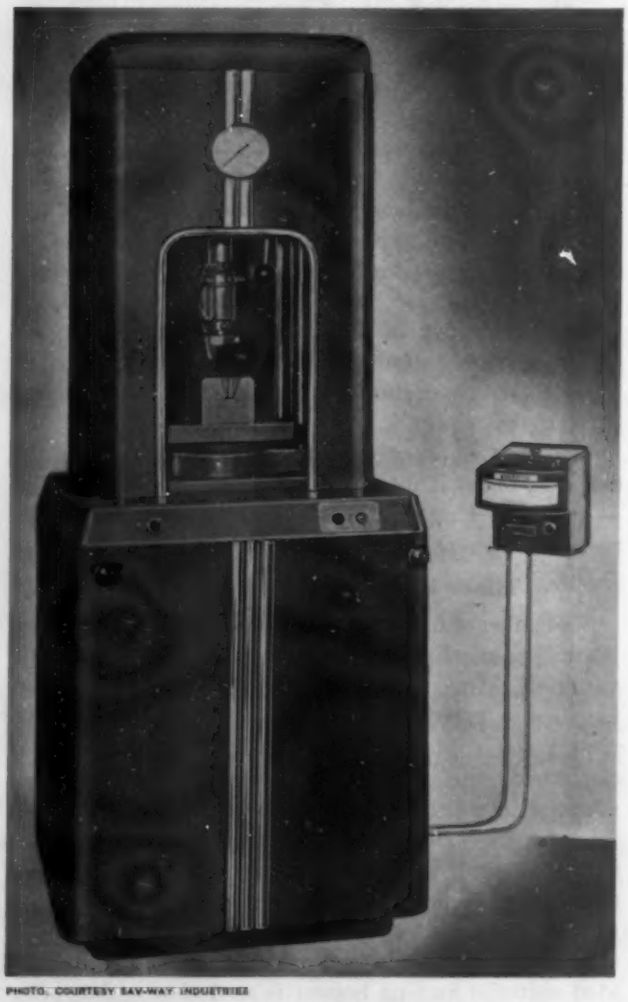
For the compression molder, the F. J. Stokes Machine Co. had a new fully automatic compression molding machine with a capacity of 15 tons (Fig. 10). The safety device, a feature of the unit, weighs finished moldings within a fraction of a gram and operates a safety cut-off which stops the machine and signals for attention should a molded piece stick in the mold or be of insufficient weight. Another safety feature is a combination push-off designed to eject the parts mechanically if the multiple air jets do not blow the molding into the trap. The machine also has a triple feed device which can be adjusted to distribute exact quantities of molding powder where it is desired in the mold.

An injection-compression unit

A plastic molding machine which combines two types of molding in one frame was another development of the year 1945.[6] This machine makes possible the application of a combination of injection and compression molding techniques to thermoplastic molding. The process retains all of the advantages of injection molding such as absence of fin, speed of production, etc., without losing the high-pressure on the material that is characteristic of compression molding. And an extra cost inherent in most injection molding, namely, the expense attendant upon the removal of gates, is eliminated in the combination method.

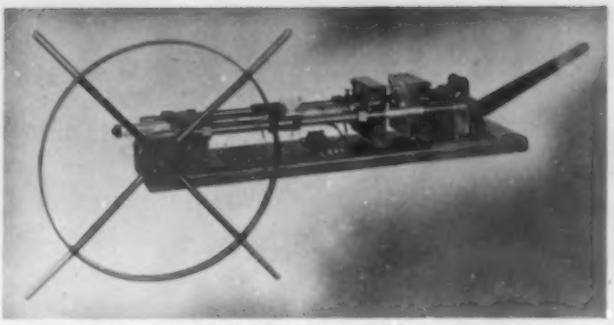
Advantages inherent in the compression molding technique have sometimes been found essential for the production of heavy sectioned thermoplastic parts. While this method nearly always eliminates sink marks, flow lines bubbles and strains, it greatly slows the rate of production. With this new machine, developed by

[6] "Injection-compression molding of acrylic feeder heads," MODERN PLASTICS 23, 146–150 (Sept. 1945).



PHOTO, COURTESY SAV-WAY INDUSTRIES

8—The capacity of this laboratory press for the injection of thermoplastic materials is rated at from 1 to 2 ounces



PHOTO, COURTESY VAN DORN IRON WORKS CO.

9—All power for the operation of this laboratory injection machine is supplied manually. The unit has a clear platen area measuring 8 by 8 in. and a 4 in. mold opening

the Improved Paper Machinery Co., this disadvantage is eliminated.

The machine, shown in Fig. 11, makes use of a vertical rod-type press with an overhead hydraulically actuated toggle clamping mechanism and an upward acting auxilliary hydraulic ram. The overhead toggle furnishes enough pressure to insure a tight clamp on the molds at all times; the upward acting hydraulic ram operates as a compression plunger. The thermoplastic material is fed into the mold from the side by a separate material heating and injection assembly. Just prior to the injection stroke, this unit moves forward on tracks until the tip of the nozzle comes in contact with the opening into the mold—a motion actuated by a small hydraulic ram which also furnishes sufficient pressure to hold the nozzle tight against the mold. A fourth hydraulic ram furnishes an injection pressure of 23,000 p.s.i.

If full advantage is to be taken of this unique machine, the mold must be designed so that one portion of the die is movable. So constructed, the movable section acts like a piston and is operated by the upward acting hydraulic ram in the vertical press. Figure 12 shows a mold of this type with the movable plug in the lowered or retracted position. In this position, the mold has a much greater capacity for material. This makes possible the injection of the weight of material required for one shot with no appreciable pressures being developed in the mold. At this point, the material is in the form of a curled up mass of properly plasticized thermoplastic.

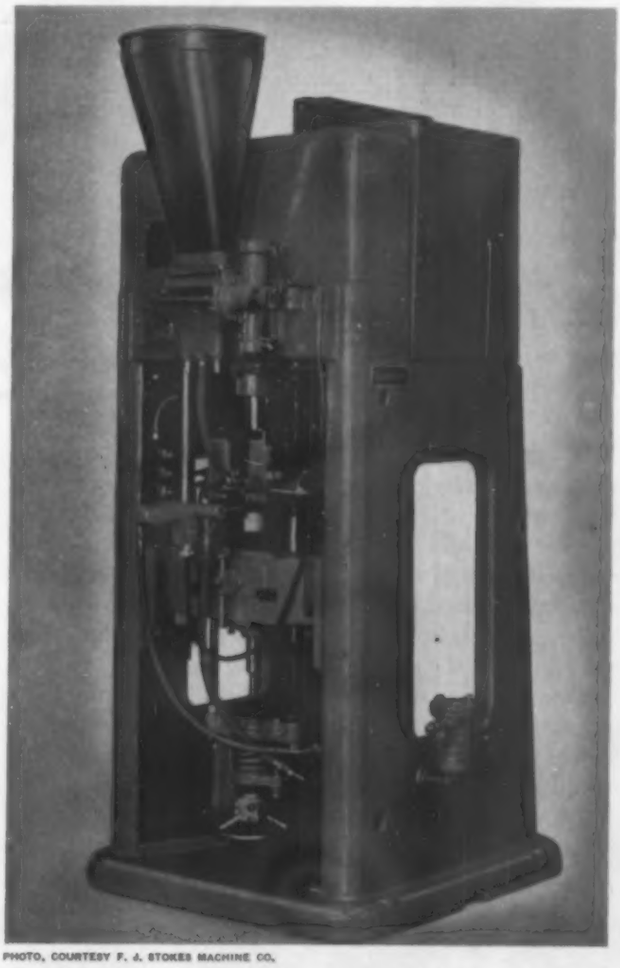
Immediately after the injection stroke, the compression ram moves upward. This motion carries the movable plug of the mold back into its proper position in the mold, shearing and blocking off the gate and, finally, compression molding the part. Figure 13 shows the mold and its component in this final position with the gate sheared and the mold completely filled out with the thermoplastic material under the high pressure built up through compression molding the part. After a suitable cooling period, the injection and heater assembly returns to its neutral position, the clamping mechanism opens the mold and the part is ejected.

This machine with slight modifications and proper mold design will also automatically shear the gates from multicavity injection molds. And it is possible to use this equipment for transfer molding with the one stipulation that the material be transferred in an upward, rather than a downward direction. In this case, the material heater and injection unit is not used, and the toggle mechanism is used for mold clamping, the upward acting hydraulic ram as the transfer plunger. This machine is a versatile unit and will, no doubt, be put to new uses in the near future.

High-frequency preheaters

The high-frequency generators used by the plastics industry are really not very different from standard radio transmitters. Thus, the fact that there have been no startling developments during the past year in the field of high-frequency preheaters, does not mean that there have been no advances at all in the industry.

The various manufacturers of radio transmitters have made radical changes in the appearance of these sets, and given a great deal of thought to the redesign of the part of the preheater which suspends the preforms in the high-frequency field and of the electrodes themselves. New safety devices have made their appearance as stock items and automatic controls have been developed which greatly aid the molder in operating



PHOTO, COURTESY F. J. STOKES MACHINE CO.

10—A fully automatic 15-ton compression molding machine

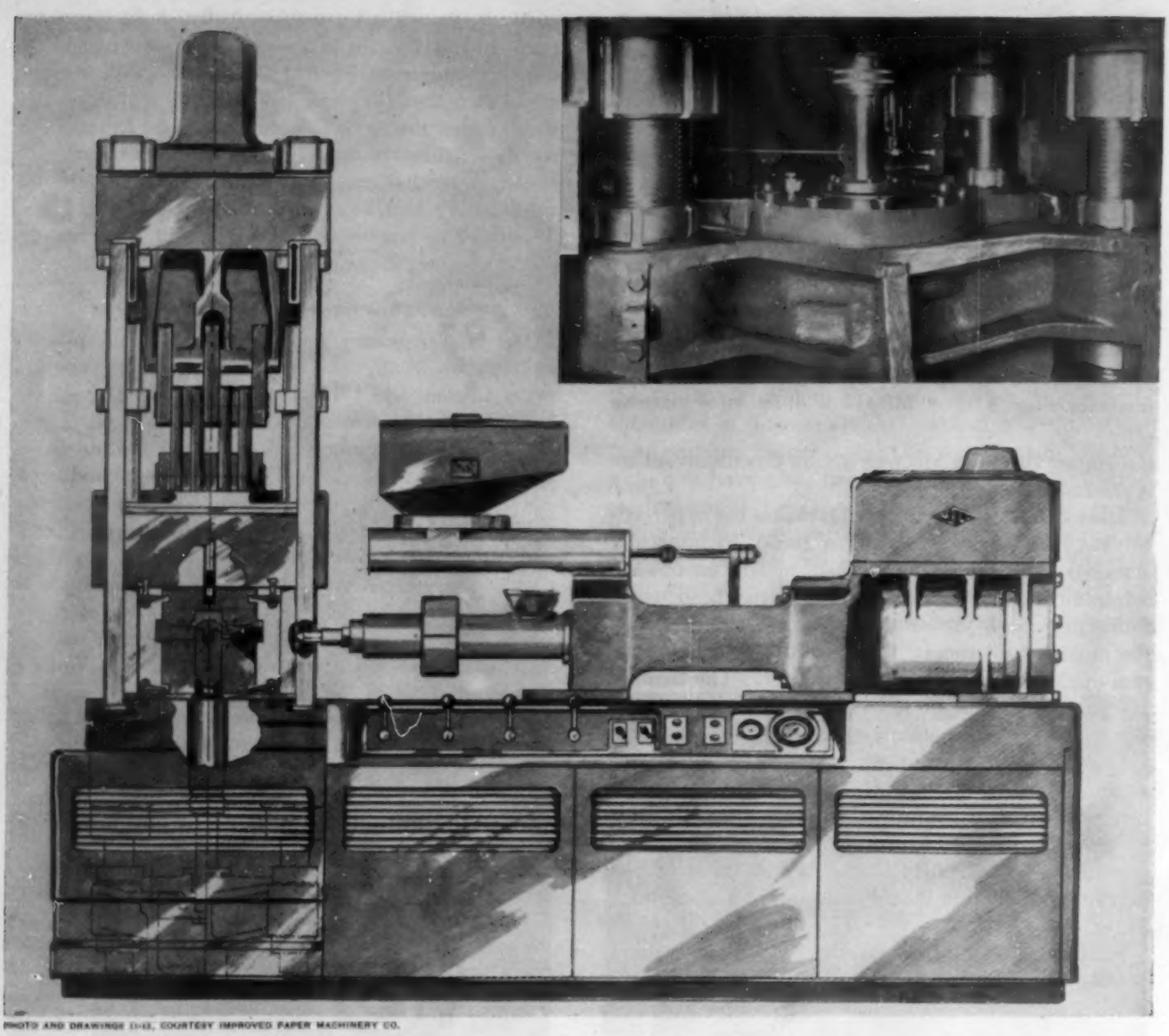


PHOTO AND DRAWINGS 11-13, COURTESY IMPROVED PAPER MACHINERY CO.

11—This unit makes possible the application of a combination of injection and compression molding techniques to the molding of thermoplastics. The insert is a closeup view of the ram

this equipment, some manufacturers even go so far as to put two independent sets of time and power controls on their units. This type of setup makes it possible for one oscillator to handle two different loads alternately or in sequence, an arrangement which permits one oscillator to preheat material for two entirely different molds by using two sets of push buttons. The portability of the units is a great advantage.

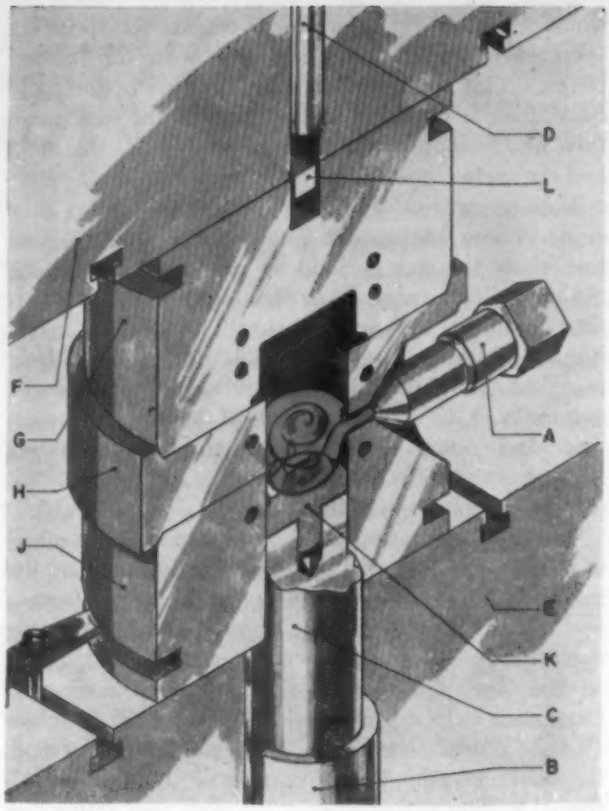
During the past few months there has been a great scramble for wave length allocations by the manufacturers of all types of radio-frequency equipment, including standard radio broadcast transmitters, frequency modulation transmitters, ship-to-shore radio telephony, private and public point-to-point radio telephone communication, and many others. Much has been written pro and con regarding the advisability of allocating only certain narrow wave bands for industrial high-frequency equipment. The Federal Communications Committee has already set aside two narrow bands and devised a tentative ruling allowing no deviation from these bands even though the equipment is shielded so that no appreciable radiation is detectable.

The High Frequency Committee of the S.P.I. has obtained permission from the Federal Communications Committee to undertake a study of just what is required in the way of shielding to absolutely eliminate radio interference from oscillators even though they are not held in the narrow frequency bands previously allocated. To a large extent, the final decision of the FCC both as to oscillator design, operation and equipment, will depend upon the results of this study.

Contact pressure molding

One rather ingenious improvement upon a well-known process to come to light during 1945 involved the contact pressure molding[7] of defroster ducts on the

[7] "Air ducts on the B-29," MODERN PLASTICS 22, 136–140 (Aug. 1945).



12—A section of the mold for an acrylic feeder head in this compression-injection molding machine. The material has been injected into the mold cavity but has not filled out the mold. Compression ram and part of mold is retracted

B-29. Due to design problems in this ship, it was necessary that these ducts be produced in all sorts of tortuous shapes, none with the attribute that makes for a good low-pressure molding job.

Previously, production of somewhat similar parts had made use of a plaster male form which was broken out after the laminate was cured. It was decided, however, that a low melting point (250° F.) metal could be used in this new process. To do this, a wood pattern was made, after which a phenolic impregnated plaster of Paris mold was poured. This plaster core was used to make a thin-walled 2-part aluminum female mold. In this method, the two halves are placed together and the low melting point metal, heated to 300° F., poured into the mold. Before pouring, the aluminum female mold is heated to about 150° F. in order to insure a smooth outer surface on the male casting.

The same technique is used in this pouring process that is employed in pottery making, that is, the heated cerrebase metal is poured quickly in and out of the aluminum mold. Therefore, the male cast is itself a hollow shell with walls approximately 1/4 in. thick. Where the part is unusually large, or the diameter is such as to put added strain on the cast, the molded cerrebase is allowed to remain in the mold for a slightly longer period of time. The longer it remains, the thicker the walls will be (Fig. 14).

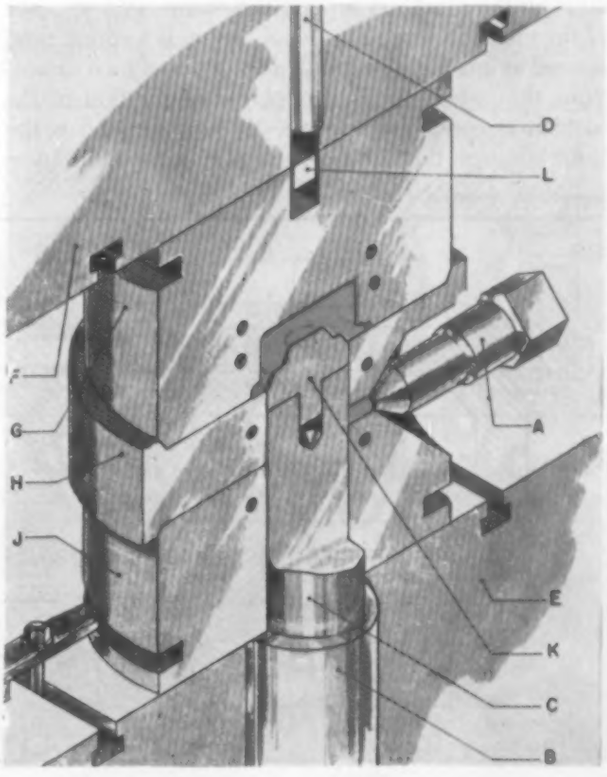
Resin impregnated fabrics—impregnated Fiberglas in the case of the defroster ducts—are then wrapped about the form either by machine or by hand. After the required thickness is obtained, the wrapped forms are placed in an oven for curing. Upon curing, the forms are removed from the oven and, while still hot, placed in an oil bath maintained at a temperature of 300° F. Since the metal shell, on which these ducts have been wrapped, melts at 205° F. and since they are already at an elevated temperature as the result of being kept in the oven during curing, the process of melting the metal from inside the ducts is a matter of minutes. The molded part is then removed and passed through a degreasing bath, after which they are ready for the normal finishing operations.

Artificial limbs are among the possible postwar applications of this production method. It is natural that the manufacture of these parts should be considered since it has been proved that the methods used in the manufacture of air ducts are most effective when employed in circular or round applications.

Marking molded parts

A new approach to the problem of constructing a mold for a circular article with accurate markings around the periphery also made its appearance.[8] Instead of resorting to many loose sections which tend to slow down the cycle and leave unsightly parting lines,

[8] "Spring rings for side markings," MODERN PLASTICS 22, 138–140 (Feb. 1945).



13—Here the compression ram has been raised, forcing the acrylic material into all portions of the mold cavity. This same movement of the ram served to cut the gates

PHOTO, COURTESY PARAMOUNT RUBBER CO.

14—Contact pressure molding proved the best method of forming the tortuously shaped defroster ducts for the B-29. The cerrebase metal forms, around which the glass cloth finally is wrapped to form these ducts, are cast in aluminum molds

this mold designer makes use of a single insert to produce all the markings around the entire circumference of the molded part. This loose section is a spring ring, opened at one point and with a diameter of such dimensions that when the ring is placed in position in the mold it is completely closed. The ring, which is the same width as the finished part, is made to a thickness which gives the ring the proper tension for springing open when ejected from the chase with the molded pieces. This spring action upon the part of the mold insert frees it from the molded piece. The spring can then be recompressed, placed in position in the mold and the cycle repeated.

This spring ring will mold perfect characters in a clean smooth background except for a single parting line where the ring is divided. Raised characters on the ring will produce sunken characters in the product; ring characters that are sunken will mold raised markings. It is well to note that this method is entirely practical only in the injection molding of thermoplastic material and the transfer molding of thermosetting plastics. It is not so effective with compression molding because of excessive internal pressures and the fact that material gets in back of the ring.

The designer states that the problem in this method of mold design was that of producing markings on the inside of the spring ring. He suggests two solutions—one consists of swaging the inside of the metal ring against a hardened die, the other of depositing copper on the face of a wax imprint of the required ring. Later, this strip is backed up with steel which is subsequently turned to exact size. Regardless of method, the final operation is the parting of the ring with a special milling cutter so that the springing action can take place.

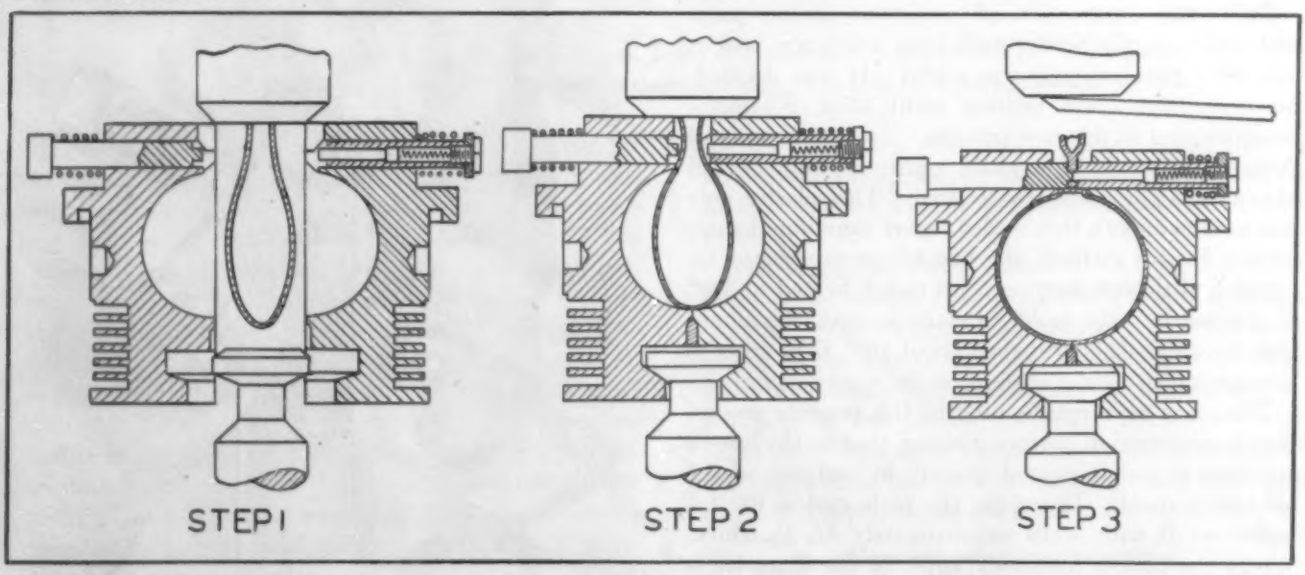
Blow molding

The molding of hollow articles by blow molding came in for a good share of attention.[9] The art may be roughly divided into the following two fields:

1. The indirect method in which an existing shape

[9] James Bailey, "Blow molding," MODERN PLASTICS 22, 127–133 (April 1945).

DRAWINGS (3), COURTESY PLAX CORP.



15—The blow molding of a Christmas tree ball on a modified injection molding machine. In Step 1, a small extruded tube hangs suspended between the open halves of the mold. When the mold halves close about this extrusion (step 2) they pinch the bottom. The blowing continues until the plastic takes the form of the mold. When the plastic reaches this shape it is thin and freezes very rapidly in contact with the cold mold

such as a rod, sheet or tube is blanked out, reheated and then blown to final shape.

2. The direct method in which molding powder is made plastic, then formed into an intermediate shape and blown into final shape in a rapid sequence of operations.

In the article's description of the indirect method of blow molding, which has been used for many years in the manufacture of toys, several sketches were used which indicated the actual movement of various points on the sheet and the resultant variation in wall section as the blowing of this softened plastic sheet proceeded. Figures illustrating this phenomenon covered a sheet blown in various shaped molds as well as one being free blown (Fig. 15). The method of blowing a preheated tube to a complicated contour was described (Fig. 16).

The portion of the article on the direct blowing method listed thousands of different combinations of the four major considerations important in producing a hollow shaped article by this process. These considerations were classified as:

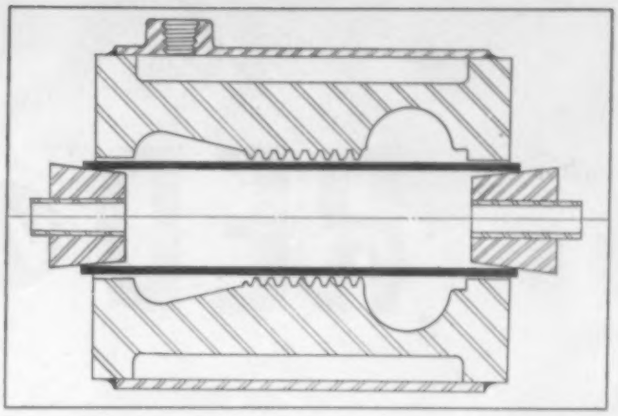
1. Softening the plastic.
2. Forming a blank or parison.
3. Blowing simple shapes and blowing complicated shapes.
4. The type of machine.

The author, however, finally limited himself to accurately describing the blowing system used by Plax Corp. He dwelt on the production of a thermoplastic standard Glass Container Association neck bottle and upon the mass production of a Christmas tree ball. While this was not the first article ever published on this process, it was the first time that all of the confidential parts of this process had been released.

Molded wood

The impregnation and molding of solid wood[10] to final form for use as brushbacks, knife handles, knobs and many other applications was another process released in the spring of the year. Whereas compreg, impreg, pregwood and similar materials are representatives of the *laminated* type of molded wood, this impregnation

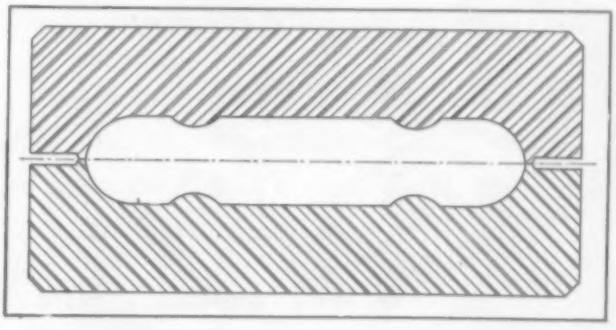
[10] S. H. A. Young and R. A. M. Palese, "Molded wood," MODERN PLASTICS 22, 100–104 (May 1945).



16—This drawing depicts a piece of tubing, inserted in a mold, ready to be blown to a very complicated contour

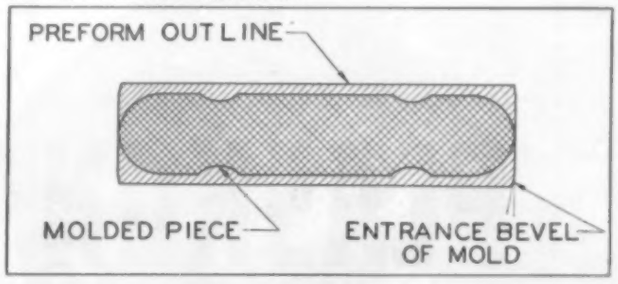
and molding makes use of solid preforms roughly formed to the shape of the finished article. With this process, not only is the inherent natural beauty of the wood retained, but the product is rendered water, acid, alkali and heat resistant and given improved dimensional stability. The procedure is relatively simple and the final cost of the article moderate due to the elimination of most of the preshaping work (Figs. 18 and 19) and the costly finishing operations necessary on natural wood. Another advantage claimed for this process is that it makes possible the utilization of cheap woods in products where normally they would not be satisfactory if made of such materials.

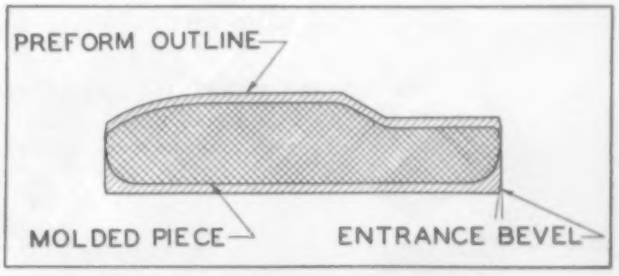
Wood must first be dried, then placed in the impregnation chamber. A vac- (*Please turn to page 190*)



17—The typical flash-type mold for the forming of wood

FIGS. 17-19, COURTESY ENGINEERING ASSOCIATES





18 and 19—The procedure of molding impregnated blocks of solid wood is relatively simple and inexpensive due to the elimination of most of the preshaping work. Where a major variation in section thickness is not involved, it is only necessary that the basic contour of the part be followed

RED vs RED

- Red . . . the angry color of destructive fire!
- Red . . . eye-arresting color of the nation's watch-dog against fire—*the A. D. T. Aero Automatic Fire Detecting and Alarm System!*
- The cover of this control box is Plaskon Molded Color . . . a brilliant, permanent vermilion that shouts "Here I am!" when fire must be fought.
- One important feature of Plaskon plastics is the wide range of never-fading colors available. Rich, handsome colors that can be used efficiently for both their practical and beautifying value. In gay, brilliant hues or restrained tones, ranging from jet black to neutral white, Plaskon can be molded economically to harmonize with the character of a wide range of products.
- Molded Plaskon is strong and non-shattering. It has a smooth warm surface; is unaffected by oils, fats or common organic solvents; and is highly resistant to arcing or tracking under high voltages and high frequencies.
- We can give you helpful assistance in suggesting designs, qualified Plaskon molders, and technical advice so that you can efficiently adapt Plaskon Molded Color to your manufacturing and sales programs.

PLASKON DIVISION • Libbey • Owens • Ford Glass Company
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PLASKON
TRADE MARK REGISTERED
MOLDED COLOR

Molded by General Electric Company, Meriden, Conn., for American District Telegraph Company

These polystyrene floats (right) have cut the loss of chromic acid in plating baths by 64 percent. They are formed from extruded tubing pinched at 2-in. intervals

PHOTOS, COURTESY THE UDYLITE CORP.

(Left) By covering the surface of a plating bath with polystyrene chips, the oxygen and hydrogen bubbles are broken before leaving the surface. Floats are preferred to chips or rods as a covering agent because of their bouyancy and because they do not stick to the plated articles thus badly clogging the drains

Polystyrene for plating baths

FOR many years, metal platers have had to take into account, when figuring their costs, a sizable loss of chromic acid in the plating bath. This so-called spray loss, occurs because the plating action causes hydrogen and oxygen bubbles to be formed. These bubbles, being lighter than air, first flow to the surface of the bath and then blow off into the air.

Many methods have been tried in an effort to trap these bubbles before they float from the surface of the bath. One idea was to cover the exposed surface of the bath with granulated polystyrene which has a lower specific gravity than chromic acid and for this reason will float on the surface of the bath. It was found that when the entire surface of the bath was covered with these chips, the bubbles were broken before they left the surface, reducing the spray losses about 60 percent.

However, use of polystyrene chips presented a number of problems. Removal of the parts after plating, necessitated their being drawn through the layer of chips with the result that the chips clung to the surface of the plated parts and were carried over into the next, the rinsing, operation. Here the force of the rinsing water washed off the chips which clogged the drains. This had two disadvantages—it necessitated frequent cleaning of the drains and caused a loss of chips.

The fact that the chips, while having a greater buoyancy on chromic acid, do not have a very great factor of safety in buoyancy also caused difficulty. After absorbing even a small amount of water, the chips had to be washed and dried or they would sink. In an effort to circumvent this problem styrene rods $^3/_8$ in. in diameter and 2 in. long were substituted for the chips. Use of these rods eliminated the difficulty of clogged drains and lost polystyrene but failed to solve the question of buoyancy.

Hollow polystyrene floats were next put on trial. Due to price, it was not feasible either to mold these floats or to produce them by the blowing method. The Yardley Plastics Co., however, developed a method of continuously extruding a tube of polystyrene and pinching it at 2-in. intervals. This pinching operation, which sealed each float from the next, was accomplished by having a gear wheel pass over the plastic tube at a speed corresponding to the speed of extrusion. Each tooth of the gear as it came in contact with the extruded polystyrene, pinched the hot material together so that the inside walls were sealed airtight.

Because of the size of these floats, there is no danger of their sticking to the plated articles as they are removed from the bath and hence clogging the drain. The added buoyancy which is given the polystyrene by its formation into floats makes drying of the material at repeated intervals unnecessary. According to the Udylite Corp., the company supplying these floats to the plating industry, about 2 lb. of the floats should be used per square foot of solution surface.

start with Tenite

Starter pedals molded of Tenite equip Harley-Davidson motorcycles. The plastic pedal is tough and durable and successfully withstands the kicks of heavy heels. Replacing steel-tube starters, the Tenite pedal has a colorful, permanent finish which requires no protective coatings against corrosion. The extremely light weight of Tenite is also an advantage. Since speed of the motorcycle depends to a large extent on its lightness on the road, the weight of all accessories must be kept at a minimum.

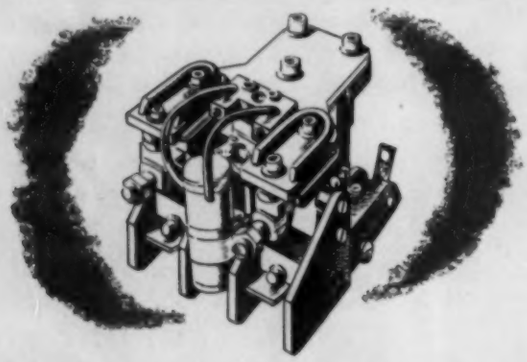
Grips, lamps, chain guards, and horns for motorcycles and bicycles were popular pieces of prewar equipment molded of Tenite. Once again, the use of Tenite for such products as these is unrestricted. Get an early start by writing for further information on Tenite to

TENNESSEE EASTMAN CORPORATION
(Subsidiary of Eastman Kodak Company)
KINGSPORT, TENNESSEE.

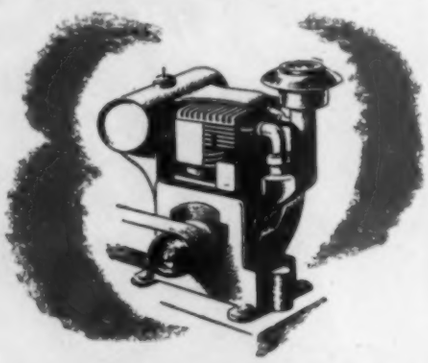
An Eastman Plastic

Starter pedals molded by Sobenite, Inc., for Harley-Davidson Motor Company.

Melmac *plastic...*



INSULATING PARTS for heavy-duty industrial control, used in mines and places where service conditions are severe, withstand heavy arcing caused by dust, dirt, or dampness, as well as damage from impact, when molded of MELMAC rag-filled material.



PORTABLE AND STATIONARY GASOLINE ENGINES start quicker, operate more efficiently, and give better service when ignition assembly parts are molded of MELMAC plastic, the high-dielectric for electrical applications.

timing factor for a Tractor

● From the moment this molded MELMAC* plastic distributor cap is snapped into place, a Ford-Ferguson tractor is off to a good start. Delivery of accurately timed, positive, high-tension spark through the distributor is assured. When the tractor goes out into the field it is ready to operate under unusually tough conditions. Because of MELMAC's sturdy insulating properties, flashovers and shorts caused by dust, dirt, and dampness, do not scorch conducting paths across the distributor cap. This all-important piece of mechanism delivers a "hot" spark, without leakage, to insure perfect timing.

Mineral-filled MELMAC, the high-arc-resistant plastic, has been developed by Cyanamid for distributors, magnetos, and other electrical parts. Its high heat resistance, non-inflammability, and resistance to arc tracking under the most severe conditions, mean uninterrupted performance, longer life, and improved serviceability of electric equipment.

Complete information on this specialized industrial plastic is contained in the handbook, "*MELMAC MOLDING COMPOUNDS,*" which will be sent you on request. We shall also be glad to work directly with you on putting MELMAC to work to meet your dielectric needs.

*Reg. U. S. Pat. Off.

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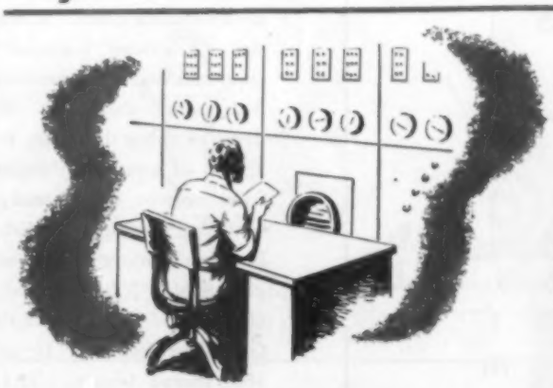
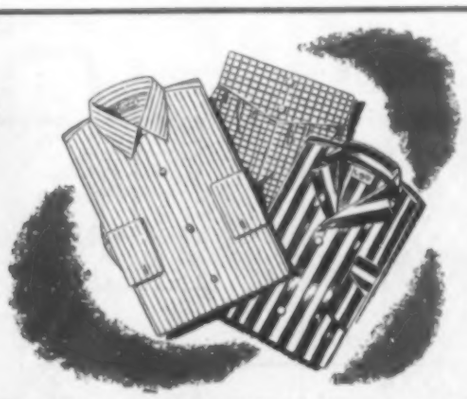


PANELS AND SWITCHBOARDS made of MELMAC resin glass-cloth laminates guard against electrical breakdown because the material will not support combustion, shows no carbon tracking, and has higher shock resistance.



MELMAC PLASTIC BUTTONS can stand repeated laundering without cracking, checking, warping or peeling, and without losing any of their original color or luster. They can be molded at low cost with complete assurance of uniform strength and unvarying color.

Design standards for inserts

AS the second step in its previously announced intention of providing the plastics industry with the best engineering production information obtainable, the Society of the Plastics Industry has made public Chapter No. 2, "Design Standards for Inserts—Their Application in Plastics Parts," of the Technical Handbook which it is compiling.

The chapter was written by top-ranking technicians who have had wide experience in the use of inserts. These men have pooled their knowledge and have combined it with data obtained from other sources, for the particular benefit of those whose operations are concerned with inserts. All of the problems which producers of articles with inserts encounter are covered in this chapter.

Through special permission of S.P.I., MODERN PLASTICS magazine is able to present the contents of this chapter herewith. Anyone desiring extra copies, may obtain them from S.P.I.

I. Scope

a. The technicians who were selected to prepare this engineering standard have endeavored to compile their own knowledge as well as that of the entire plastics industry in preparing this engineering information. Engineers having a reasonable knowledge of plastics and an acquaintance with inserts and their use will find this standard of value in insert design and selection.

II. Screw machine inserts

The use of inserts in every type of molding operation presents certain difficulties, which should be recognized by the user. Where inserts are required for purposes of adding to the strength of the hold-down screws; for reasons of added life to the screw thread such as is required where covers must be frequently removed, etc.; for electrical conduction; or for numerous other reasons, it must be realized that the addition of inserts will slow down the molding cycle and will add to the cost of production. However, ingenious design frequently demonstrates that inserts may be eliminated or that the metal parts may be added subsequent to molding, and that such metal parts may be added by automatic means at a rate faster than is possible by incorporating such parts in the molding operation. Very often a tapped hole in the plastic material, a drive screw, a self-tapping screw or bolt and nut can be used, with resultant saving in the cost of the molded part.

Although the ordinary screw-machine type round insert is common, numerous designs (Fig. 2), are used.

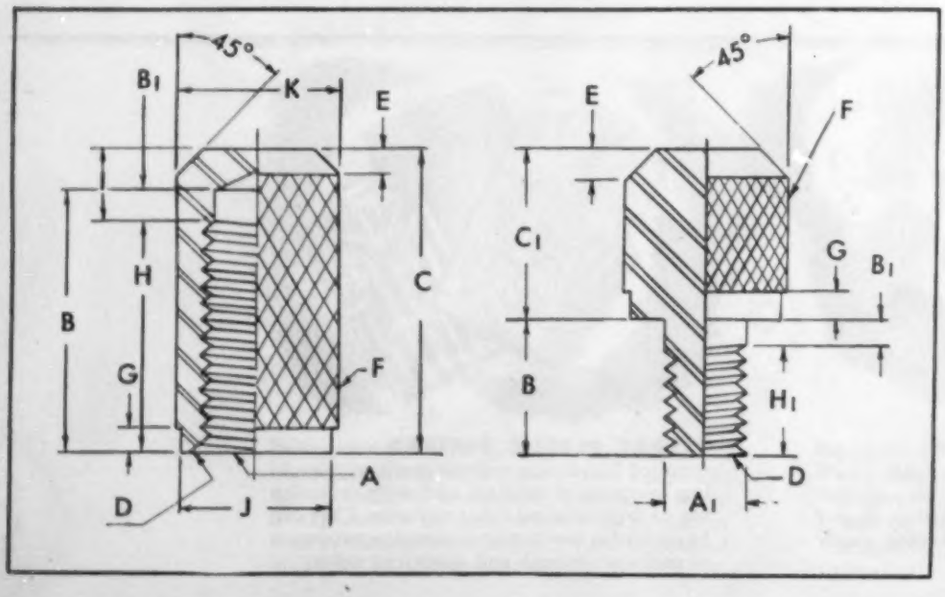
III. Dimensions and tolerances

a. Maintaining a proper tolerance on various dimensions of inserts has always been a problem to the plastics industry as well as the insert manufacturers, mainly because of the lack of information on design and standardization of dimensions.

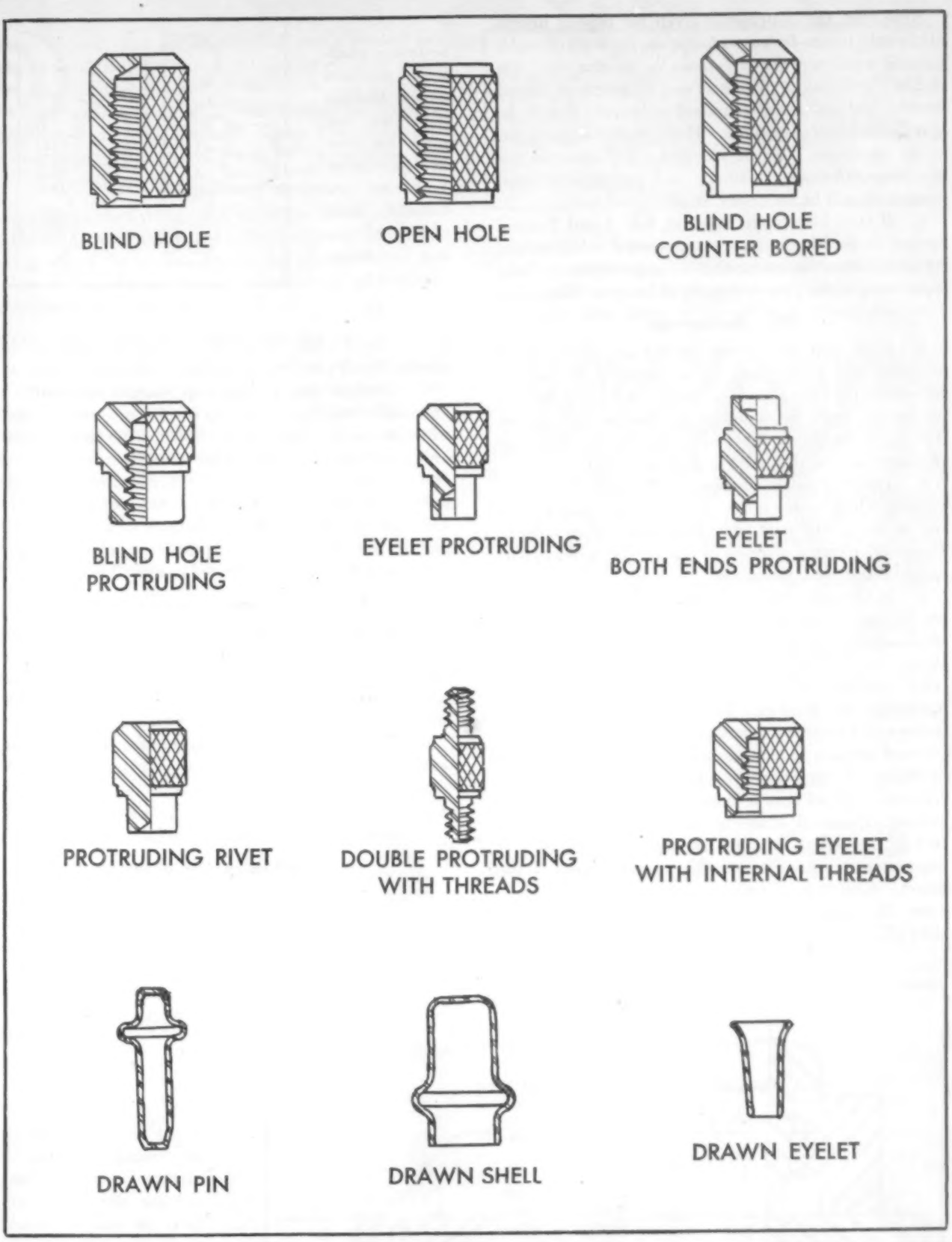
b. Dimensions and tolerances for the usual type male and female inserts in Figs. 1 and 2 were compiled with the cooperation of the National Screw Machine Products Association as being practicable for machining as a single operation on an automatic screw machine.

In Fig. 1 the regular tolerance on the minor diameter (A-2) is +.0025 in.; the precision tolerance is −.0005 in. The regular tolerance on the length (C) is ±.010; the precision tolerance is ±.001. The length of the male body insert (C-1) is ±.010. The minimum length for the sealing diameter (G) is $^1/_{32}$ inch. The amount of usable thread (H) should be $1^1/_2$ times the diameter.

(*Please turn to next page*)



1—Tolerance index. A: tap size "American National" class 2; A-1: major diameter; A-2: minor diameter; B: depth of minor diameter; B-1: no. of unusable threads from bottom (cut thread); C: tolerance lengths; C-1: body male insert; D: thread chamfer 45° ± .005; E: body chamfer 45° ± .010; F: knurl; G: sealing diameter; H: usable thread length; H-1: length of usable thread H-1 + B-1 = B; I: amount to add to H to obtain C. H+I = C; J: sealing diameter, ±.002 K: min. bar stock diameter



2—Various designs for screws and drawn inserts. These drawings include inserts with male and female threads and indicate the designs that can be used for various applications. From right to left, top to bottom, there are inserts for the blind hole; open hole; counter bored; blind hole protruding; eyelet protruding; eyelet, both ends protruding; protruding rivet; double protruding; protruding eyelet with internal threads; drawn pin, shell and eyelet

Note that the dimensions given for tapped inserts apply only to *non-ferrous metals where the depth of usable tapping is not more than 1 1/2 times the tap diameter.* On *A*-2 in Fig. 1 (minor diameter) and *C* (length of tapped inserts) the maximum standard tolerance should be specified whenever possible. However, for closer tolerances "precision" can be specified. To maintain the precision tolerance, reaming and other additional operations will be necessary at additional cost.

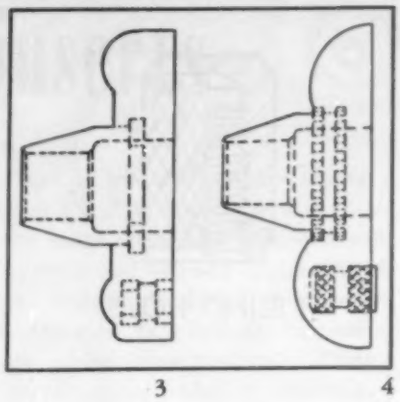
c. If steel inserts are required, Fig. 1 and Table I cannot be used in design without several modifications which will result in inserts that are more expensive than is the case when they are made of brass or aluminum.

IV. Anchorage

a. Firm and permanent anchorage of inserts is essential and since there is no chemical or natural adherence between plastic materials and metal inserts, anchorage must be obtained by mechanical means. The slight anchorage that is obtained by the shrinkage of plastic around the insert is never sufficient.

b. Inserts must be anchored sufficiently to prevent turning when torque is applied and to prevent pulling out of the plastic part when it is subjected to tension. However, internal stresses in the plastic molded part must be kept to a minimum.

c. In the early days of plastics, it was customary to use hexagon stock for inserts (Fig 3). This practice is mechanically incorrect except in some special applications. Hexagonal stock provides torsional anchorage only. Grooves must be machined to obtain sufficient anchorage in tension. The combination of sharp corners and grooves on hexagonal stock set up certain internal stresses in the material which often result in cracking. In practically all instances, round stock is recommended so that a diamond knurling can be obtained. Diamond knurling provides the most satisfactory anchorage from the standpoint of torque and tension, and minimizes possible cracking around the insert. Knurling of inserts is best accomplished in screw machines with *end* knurling tools. The stock sizes given in Table I are ample to allow end knurling



3 4

3—Inserts which are produced from hexagon stock are not suited for plastic application. 4—Grooves and diamond knurl supply a very firm anchorage

and to leave sufficient stock for a proper *sealing* diameter free of knurling at the open end of the insert.

d. Grooves can be used in conjunction with a diamond knurl, Fig. 4. Sharp corners must be avoided when machining the grooves. When using grooves, provide a wide groove in the center of the insert rather than two grooves, one on each end. The center groove allows the material to shrink or creep toward the center and consequently results in minimum strain within the piece—thus eliminating the possible cracking. Right and wrong design are illustrated in Figs. 7 and 8.

V. Torque and tension testing

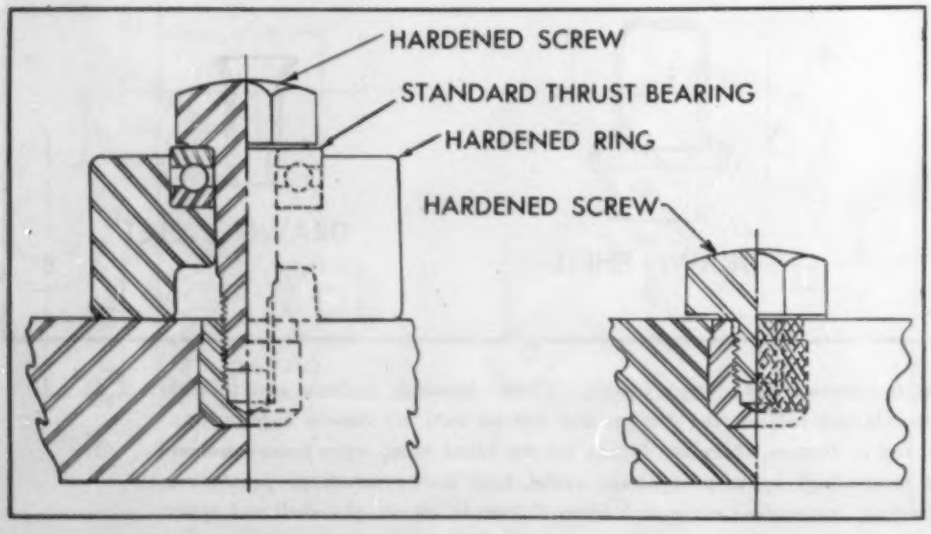
a. A simple inexpensive method of test is recommended. Figure 5 illustrates the method for tension and Fig. 6 for torsion. When conducting the torque test, a line can be scribed on the surface of the insert and the plastic in order to detect the slightest turn.

b. It is essential that special hardened and ground screws be used to eliminate friction; and the screws should be well lubricated before the tests are started. A standard graduated torque wrench is recommended. Results of the tests are indicated in inch-pounds torque.

VI. Wall thickness of inserts

a. Minimum wall thickness of metal on the inserts depends entirely upon the accuracy desired on the inside dimensions of the insert. If too thin a wall of

5 6



5 and 6—Simple methods for testing the tension strength (extreme left) and the torsion strength (left) of knurled inserts

metal is used, the combination of stress caused by shrinkage of the plastic material and by molding pressure may collapse the wall of the insert. As a result, the diameter may decrease to a point out of the range of specified tolerances. Table I shows the minimum recommended diameters of bar stock for various sizes.

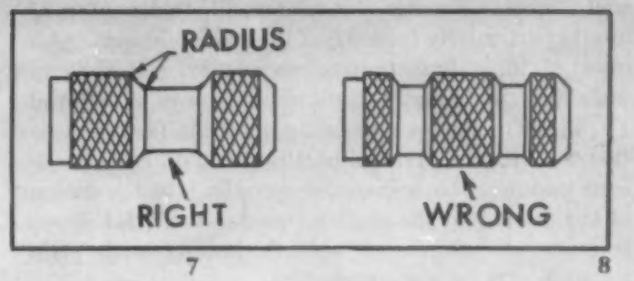
VII. Selection of metal

a. The correct selection of metal for inserts is essential because of the difference in the coefficient of expansion between the various metals and plastic materials. Table II lists the coefficients of expansion of various metals as well as of various plastics.

VIII. Minimum wall thickness around inserts

a. The thickness of the wall of plastic required around inserts depends upon: 1) whether the material is thermoplastic or thermosetting, 2) type of material within each group, 3) shrinkage of material, 4) modulus of elasticity, 5) coefficient of expansion of the material, 6) coefficient of expansion of the metal used in the inserts, 7) temperature range over which molded part will have to function, 8) moisture-sensitivity, 9) loss of flexibility caused by aging, and especially 10) the design of the insert.

b. Very often the molded part is designed first, then the necessary inserts fitted into the remaining space. If inserts are required, they should be considered first and the molded part designed around them. The shape and form of the insert govern the wall thickness of material to a great degree, especially when the inserts are of irregular shape—rectangular, square, star—or of any other shape having sharp corners.



7 8

7 and 8—Correct and incorrect methods of anchoring inserts. The insert at the left with central anchoring groove eliminates heavy strains set up in plastic materials

c. The two main factors in the properties of plastics—especially of phenolic, urea and melamine materials—are modulus of elasticity and the ability of the material to cold flow after curing so that it can stretch slightly without cracking. No one property of the material will solve the problem. For instance, a material having a low shrinkage of 0.002 in. per in. but having a very rigid setting quality will crack. Other materials which have a shrinkage of 0.010 in. per in. but not as rigid a set (retaining some elastic properties) will not crack despite a minimum thickness of wall.

It is impossible to set up comprehensive standards of

TABLE I.—DIMENSIONS AND TOLERANCES* OF NON-FERROUS INSERTS WHICH HAVE A USABLE THREAD LENGTH NOT MORE THAN 1½ TIMES THE TAP DIAMETER

A						A-1					
Coarse	*Fine*	*K*	*J*	*Tap drill*	*A-2*	*Maximum*	*Minimum*	*B-1*	*I*	*D and E*	*Knurl*
2-56		5/16	9/64	#50	0.0700	0.0860	0.0820	3	5/32	1/64	Fine
	2-64	5/16	9/64	#49	0.0730	0.0860	0.0822	3	5/32	1/64	Fine
3-48		7/32	5/32	#45	0.0820	0.0990	0.0946	3	7/64	1/64	Fine
	3-56	7/32	5/32	#45	0.0820	0.0990	0.0950	3	5/32	1/64	Fine
4-40		7/32	11/64	#43	0.0890	0.1120	0.1072	2½	7/64	1/64	Fine
	4-48	7/32	11/64	#42	0.0935	0.1120	0.1076	2½	7/64	1/64	Fine
5-40		1/4	3/16	#37	0.1040	0.1250	0.1202	2½	7/64	1/32	Medium
	5-44	1/4	3/16	#37	0.1040	0.1250	0.1204	2½	7/64	1/32	Medium
6-32		1/4	13/64	#33	0.1130	0.1380	0.1326	2½	5/32	1/32	Medium
	6-40	1/4	13/64	#32	0.1160	0.1380	0.1332	2½	9/64	1/32	Medium
8-32		9/32	7/32	#29	0.1360	0.1640	0.1586	2½	5/32	1/32	Medium
	8-36	9/32	7/32	#28	0.1405	0.1640	0.1590	2½	9/64	1/32	Medium
10-24		5/16	1/4	#23	0.1540	0.1900	0.1834	2½	5/16	1/32	Medium
	10-32	5/16	1/4	#20	0.1610	0.1900	0.1846	2½	5/32	1/32	Medium
12-24		5/8	5/16	#16	0.1770	0.2160	0.2094	2½	13/64	3/64	Medium
	12-28	5/8	5/16	#13	0.1850	0.2160	0.2098	2½	11/64	3/64	Medium
1/4-20		13/32	11/32	#6	0.2040	0.2500	0.2428	2	13/64	3/64	Coarse
	1/4-28	13/32	11/32	7/32	0.2187	0.2500	0.2438	2	11/64	3/64	Coarse
5/16-18		15/32	13/32	G	0.2610	0.3125	0.3043	2	7/32	3/64	Coarse
	5/16-24	15/32	13/32	I	0.2720	0.3125	0.3059	2	13/64	3/64	Coarse
3/8-16		9/16	15/32	O	0.3160	0.3750	0.3660	2	1/4	3/64	Coarse
	3/8-24	9/16	15/32	Q	0.3320	0.3750	0.3684	2	7/32	3/64	Coarse
7/16-14		5/8	17/32	U	0.3680	0.4375	0.4277	2	9/32	3/64	Coarse
	7/16-20	5/8	17/32	25/64	0.3906	0.4375	0.4303	2	1/4	3/64	Coarse
1/2-13		11/16	19/32	27/64	0.4218	0.5000	0.4896	2	5/16	1/16	Coarse
	1/2-20	11/16	19/32	29/64	0.4531	0.5000	0.4928	2	17/64	1/16	Coarse
9/16-12		3/4	21/32	31/64	0.4843	0.5625	0.5513	2	11/32	1/16	Coarse
	9/16-18	3/4	21/32	33/64	0.5156	0.5625	0.5543	2	9/32	1/16	Coarse
5/8-11		13/16	23/32	35/64	0.5469	0.6250	0.6132	2	3/8	3/16	Coarse
	5/8-18	13/16	23/32	37/64	0.5781	0.6250	0.6168	2	5/16	1/16	Coarse

* See Fig. 1.

wall thickness of material in relationship to diameters of inserts particularly for some of the special designs. An insert 1/4 in. in diameter requires a 1/8-in. wall while an insert 6 in. in diameter might require a wall of material 1 1/3 in. in thickness, depending upon the factors mentioned. Each individual part presents different problems and must be engineered according to the design of the insert and the material used. Table III shows recommended minimum wall thicknesses with plain round inserts for various plastics.

IX. Problems in molding usual inserts

a. *Floating of inserts*—Floating of inserts can be controlled or prevented by several methods: 1) Tapering the retaining pins slightly, starting the taper at the fillet and carrying it up to one third of the length of the pin. In most cases 0.003-in. taper is sufficient providing that the maximum tolerances of the minor diameter is maintained. If too much taper is allowed for drive fit, the insert may pull out of the material. 2) It has been found that a straight knurl on the retaining pin provides sufficient holding surface. 3) Square retaining pins can also be used. 4) Split pins are practical on blind-hole inserts. 5) Spring tension pins in which the retaining pin is slotted and music wire inserted into the slot. This method presents difficulties because the slightest flow of material into the slot prevents the spring from functioning properly. 6) An extended shoulder can be provided on the insert, shown in Fig. 1 as *J* (sealing), and this shoulder allowed to enter into the mold proper. This is an ideal method of preventing the insert from floating although it is not permissible when inserts must be flush with the surface of the material. 7) On male inserts a taper hole can be provided for a drive fit if close accuracy of inserts is maintained. In such a case, 0.0005 to 0.001 in. is sufficient. If the insert is long enough, a small side hole can be drilled in the pin and music wire inserted to provide spring action. This spring action prevents the insert from floating in practically all methods of molding. The same method can be used for holding inserts in the top half of the mold. 8) There are occasions where a more precise location of the insert is desirable and in this event removable threaded pins are provided in the mold. Inserts are screwed to these pins. However, this procedure increases the cost of production. Subsequent removal of the flash from the thread is in most cases avoided.

b. *Crushing of the insert*—In transfer molding very few difficulties are experienced with crushing of inserts if close tolerances on the length are maintained. In compression molding, however, when the insert must show on both sides and is molded vertically or in line with the press motion, crushing of inserts can be prevented by the use of preforms with holes to allow the preform to slip over the insert. Sliding pins are provided in the force plug, operated by spring, air, or hydraulic action. These pins are in a down position when the mold is being closed and they contact the surface of the inserts before the flow of material takes place. Since the pins are under constant pressure, no material can enter the insert. This method can be applied to blind or open hole inserts, and to either top or bottom pins. Considerable pressure can be applied on the inserts. Actual tests on a brass insert 1/2 in. long, with a 6 by 32 thread and a 1/16-in. wall, show that the insert withstands 6 cycles of 500 lb. total pressure with a reduction of 0.0005 in. in length. When the inserts are not of the through type but are close to the rear surface of the molded part, preheating of material and insert is recommended.

c. *Flow of material into an open-hole through-type insert*—There is very little difficulty in transfer molding, if the length of the insert is maintained from 0.001 in. to 0.002 in. oversize. When the mold is closed, the insert is pinched in the mold, and it is impossible for material to enter. In compression molding, however, it is impossible to prevent material from entering the hole unless pressure-type pins are used. The same

TABLE II.—COEFFICIENT OF THERMAL EXPANSION (30 TO 60° C.) PER DEGREE CENTIGRADE

Plastic material	*Coefficient* × 10^{-6}
Phenolics:	
General purpose	39
Medium impact	38
Medium impact, CFI-5	33
High impact, CFI-10	29
High impact, CFI-20	22
Medium heat resistance	34
High heat resistance	26
Electrical general purpose	35
Low loss	19
Arc resistance	49
	Coefficient × 10^{-6}
Cellulose acetate	80 to 160
Cellulose acetate butyrate	110 to 170
Ethyl cellulose	100 to 140
Urea-formaldehyde	25 to 30
Melamine-formaldehyde	25 to 30
Vinylidene chlcride	190
Methyl methacrylate	70 to 90
Polystyrene	60 to 80
Polyethylene	180
Nylon, Type FM-1	103
Vinyl chloride-acetate	69

Metal	*Chemical composition*	*Coefficient* × 10^{-6}
Aluminum 2S	99.2% Al	23.94
Copper	99.9+	17.71
Phosphor bronze 30	95.5 Cu, 4 Sn, 1 Zn	18.90
Phosphor bronze		16.8
Brass, ordinary	67 Cu, 33 Zn	18.5
Bronze, commercial	90 Cu, 10 Zn	18.8
Steel	99 Fe, 1 C	12
Stainless steel	90–2 Fe + 8 Cr, 0.4 Mn, 0.12 C	11
Nickel		12.9
Monel	60 Ni, 12 Fe, 11 Cr, 2 Mn	14
Silver, standard	92.5 Ag, 7.5 Cu	18
Zinc	95 Zn, 5 Al	28
Solder, half and half		24
C.R. steel		14
Silver, German		18

method is used to prevent the crushing of inserts. If pressure pins cannot be used, it is advisable (especially on larger inserts) to tap the inserts undersize before molding and retap to proper size after molding. *Extreme care should be taken in retapping to prevent stripping of the threads, specially if considerable material has flowed into the thread.* On small inserts it is economical to mold insert with a drilled hole and tap after molding.

d. *Flow of material into a blind-hole insert*—Difficulties with material flow into blind-hole inserts are not as numerous as with the open-hole types. In most cases, such flow is caused by loose retaining pins which allow the insert to float with the flow of material; by uneven machining on the face of the insert; or by knurling on the entire outside diameter of the insert, leaving extended burrs on the face which do not permit the insert to rest flat on the surface of the mold or the surface of the retaining pin. In all cases, it is good practice to provide a slight recess in the mold which will accommodate the outside diameter of the insert. When the *J* diameter (Fig. 1) of the retaining pin is the same as that of the insert and sharp corners can be retained in the hole, a depth of 0.005 in. is sufficient to prevent the plastic from flowing in. This method allows the insert to protrude above the surface of the molded part—a condition that is desirable, especially when electrical contacts are made.

e. *Protruding inserts*—Protruding inserts are frequently required and are molded in place for specific purposes. In most cases, the protruding section is used for assembly or for bearing points where mechanical action is required. In special cases, especially on large inserts where the molded part is subjected to considerable torque in order to obtain a tight connection, it is advisable to allow a hexagonal section of the insert to protrude above the molded surface for a wrench grip. Thus, strain is on the insert rather than on the plastic.

Perfect anchorage is also necessary. Where a limited wall of material must be used, the anchorage section of the insert is turned and coarse diamond-knurled. A groove can be added to increase anchorage for tension. Sharp corners must be avoided, however. In the event that the hexagonal shape is used for anchorage, sharp corners must be reduced by turning and grooves provided for tension anchorage. Fig. 9 shows recommended design.

X. Cold forged inserts

a. There are no specific formulae controlling the individual relationships of the diameters and widths of collars to the shank or controlling the kind and variety of shapes (ribbed, finned, pinchneck, hexagon and so on) which may be combined with other symmetrical or unsymmetrical shapes in one piece. For each problem, therefore, the solution should be reached through cooperation between the designer of the molded piece and the manufacturer of the insert.

b. In general, the volume or quantity needed to insure economical production by cold-heading is about the same as that needed by other production processes. Where second operations are required, such as turning, drilling and tapping, larger quantities are needed.

c. In the drawings shown on pages 149 and 153, compiled in cooperation with the Lamson & Sessions Co., Cleveland, and the Central Screw Co., Chicago, the parts, sketches and data that are given are designed to indicate the potentialities of cold-head application. None of the inserts has been machined. This could be done, of course, by either automatic or single purpose equipment. Where additional machining, drilling, reaming or tapping would be involved, the tolerances would be the same as those listed in Fig. 1 and Table I of Screw Machine Inserts section. (*Please turn to next page*)

TABLE III.—MATERIAL WALL THICKNESS FOR INSERTS OF VARYING DIAMETERS

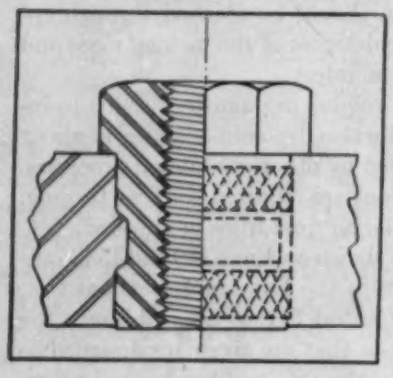
Materials	*Insert diameters*									
	1/8	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	1 3/4	2
	in.	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*
Phenolics										
General purpose	3/32	5/32	9/16	7/32	5/16	11/32	3/8	13/32	7/16	15/32
Medium impact	5/64	9/64	5/32	13/64	9/32	5/16	11/32	3/8	13/32	7/16
High impact	1/16	1/8	9/64	3/16	1/4	9/32	5/16	11/32	3/8	13/32
High heat resistant, general purpose type	1/8	3/16	7/32	1/4	11/32	3/8	13/32	7/16	15/32	1/2
High heat resistant, impact type	5/64	9/64	5/32	13/64	9/32	5/16	11/32	3/8	13/32	7/16
Low loss	5/32	7/32	1/4	9/32	3/8	13/32	7/16	15/32	1/2	17/32
Special for large inserts, flexible properties	3/64	7/64	1/8	5/32	7/32	1/4	9/32	5/16	11/32	3/8
Cellulose acetate	1/8	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	1 3/4	2
Cellulose acetate butyrate	1/8	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	1 3/4	2
Ethyl cellulose	1/16	3/32	1/8	5/32	3/16	7/32	1/4	9/32	5/16	11/32
Urea-formaldehyde	3/32	5/32	3/16	7/32	5/16	11/32	3/8	13/32	7/16	15/32
Melamine-formaldehyde[a]										
(a)	3/32	5/32	5/16	7/32	5/16	11/32	3/8	13/32	7/16	15/32
(b)	1/8	5/16	7/32	5/16	11/32	3/8	13/32	7/16	15/32	1/2
Vinylidene chloride	3/32	1/8	5/16	5/16	7/32	1/4	1/4	9/32	5/16	11/32
Methyl methacrylate	3/32	1/8	5/16	1/4	3/8	1/2	5/8	3/4	7/8	1
Polystyrene	3/16	3/8	9/16	5/4	1 1/8	1 1/2	1 7/8	2 1/4	2 5/8	3
Polyethylene	3/16	5/32	1/8	5/32	3/16	7/32	1/4	9/32	5/16	11/32
Nylon, Type FM-1	1/16	5/32	1/8	5/32	3/16	7/32	1/4	9/32	5/16	11/32
Vinyl chloride-acetate	3/32	1/8	5/16	1/4	3/8	1/2	5/8	3/4	7/8	1

[a] Melamine-formaldehyde (a): Mineral-filled melamine ignition material. (b): Cellulose-filled melamine electrical grade.

d. *Material specification*—Almost any material can be cold worked, but cold working grades of the following are preferred in the order named:

1. Aluminum and aluminum alloys
2. Brass
3. Copper and copper alloys
4. Carbon steels
5. Alloy steels
6. Stainless steels
7. Silver and other precious metals

e. *Tolerances without finishing operations*—The tolerances given for the parts on pages 149 and 153 are those ordered, closer ones could be met if necessary. Tolerances for any element such as length or diameter vary with the material and with the sizes and proportions of the piece, since they, in turn, determine the equipment or method of heading to be used.



9—Recommended design for an insert which protrudes from plastic surface

f. In general, the following tolerances can be considered as commercial without finishing operation, although in some cases special care must be exercised to meet them.

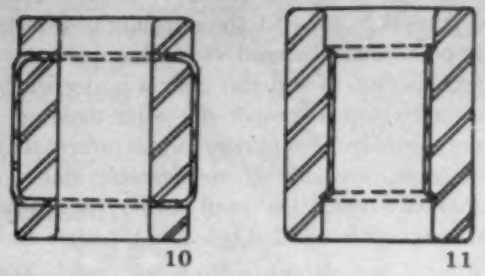
Length, in.....	±0.010 (maximum)
Fillets.....	Sharp or round, as specified
Diameter, in.....	0.002 (minimum tolerance)
Squareness, shoulders or collars with shank.....	±1° maximum

g. *Tolerances with finishing operations*—Whatever tolerance is needed can be met by adding finishing operations. For example, aircraft studs, bolts and specials are commonly made in production today to tolerances as close as 0.0005 inch.

XI. Design of special inserts

a. It would be an endless task to cover the entire field of special inserts. Some of the more important phases of design will be covered below.

b. The design of special inserts for various applications requires as much engineering, if not more, than other phases of preliminary work. In many cases, too, little significance is attached to planning on special inserts. The design engineer, the manufacturer of the insert and the molder must cooperate to obtain simplicity of insert design, which will result in the production of satisfactory parts and will aid in economical production.



10 11

10—A tubular insert should be beaded inwardly to anchor it on the outside of a molded plastic part and beaded outwardly (Fig. 11) for anchorage on the inside of piece

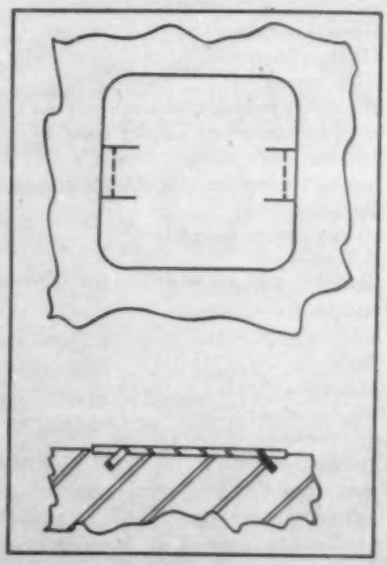
c. Typical applications of special inserts are commutators, wire and insert-connections on telephone handsets, and radio resistors where carbon or other elements are molded inside of the plastic. A radio condenser is a good example of built-up laminated insert.

XII. Special anchorage of inserts

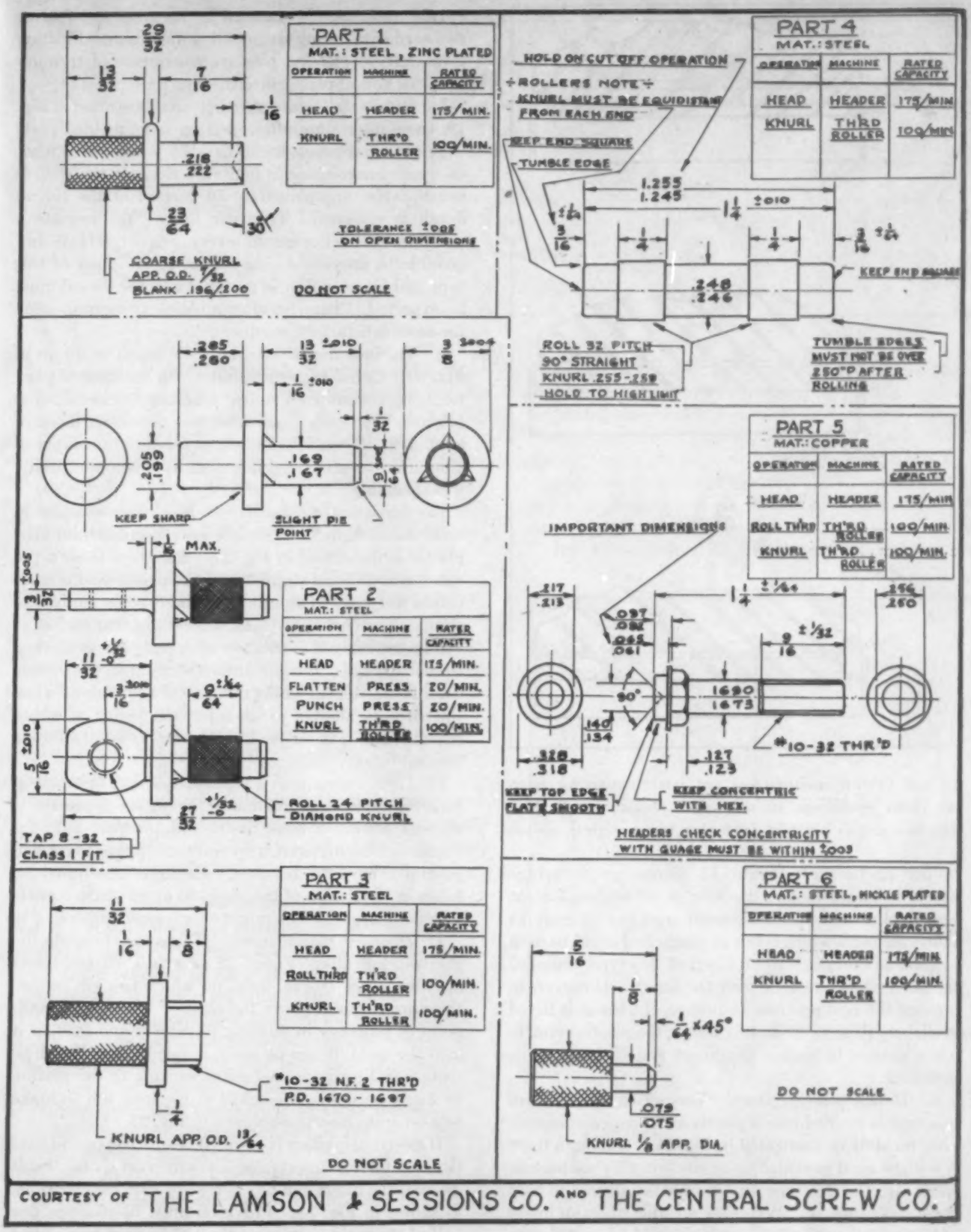
a. Anchorage of inserts depends entirely upon the design of the insert, the thickness of the material to be molded around the insert, the type and nature of the material being molded and the design of the molded piece (see paragraph IVa).

b. *Thin tubular inserts*—These inserts are extremely difficult to anchor properly. If a tubular insert is molded part way up a molded part, it is possible to invert a bead which will act as satisfactory anchorage. The bead method can be used on outside or inside inserts. Both methods are illustrated in Fig. 10 for outside inserts and in Fig. 11 for inside. A perforated surface around the circumference also can be used where permissible. When molding an outside tubular insert, it is often necessary to coat the inside of the insert with Neoprene or Vinylite to insure better bonding.

c. *Flat plate-type inserts*—These can be anchored by means of countersunk holes wherever it is permissible. Bevel all edges of the insert or, if certain sections of the



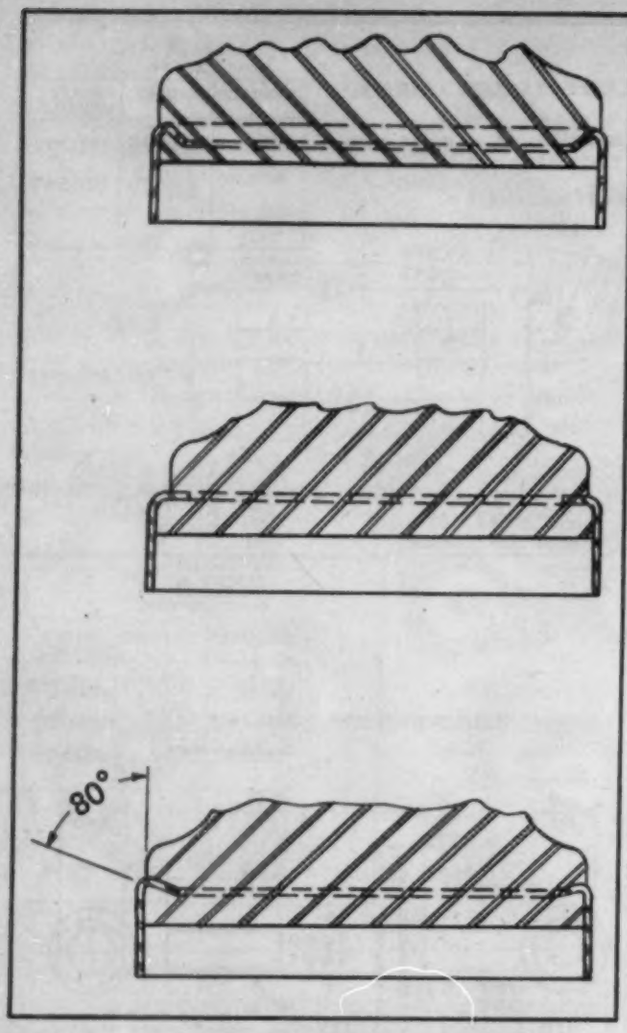
12—Flat plate inserts have their ends bent downward so that they will be securely anchored when plastic material is molded around them


PART 1
MAT.: STEEL, ZINC PLATED
OPERATION | MACHINE | RATED CAPACITY
HEAD | HEADER | 175/MIN.
KNURL | THR'D ROLLER | 100/MIN.
TOLERANCE ±.005 ON OPEN DIMENSIONS
DO NOT SCALE
COARSE KNURL APP. O.D. 9/32
BLANK .196/.200
PART 4
MAT.: STEEL
OPERATION | MACHINE | RATED CAPACITY
HEAD | HEADER | 175/MIN
KNURL | THRD ROLLER | 100/MIN
HOLD ON CUT OFF OPERATION
÷ROLLERS NOTE÷
KNURL MUST BE EQUIDISTANT FROM EACH END
KEEP END SQUARE
TUMBLE EDGE
1.255
1.245
KEEP END SQUARE
ROLL 32 PITCH 90° STRAIGHT KNURL .255-.259 HOLD TO HIGH LIMIT
TUMBLE EDGES MUST NOT BE OVER .250"D AFTER ROLLING
PART 5
MAT.: COPPER
OPERATION | MACHINE | RATED CAPACITY
HEAD | HEADER | 175/MIN
ROLL THRD | THRD ROLLER | 100/MIN.
KNURL | THRD ROLLER | 100/MIN.
IMPORTANT DIMENSIONS
90°
*10-32 THR'D
KEEP TOP EDGE FLAT & SMOOTH
KEEP CONCENTRIC WITH HEX.
HEADERS CHECK CONCENTRICITY WITH GUAGE MUST BE WITHIN ±.003
PART 2
MAT.: STEEL
OPERATION | MACHINE | RATED CAPACITY
HEAD | HEADER | 175/MIN.
FLATTEN | PRESS | 20/MIN.
PUNCH | PRESS | 20/MIN.
KNURL | THRD ROLLER | 100/MIN.
MAX.
KEEP SHARP
SLIGHT PIE POINT
ROLL 24 PITCH DIAMOND KNURL
TAP 8-32 CLASS 1 FIT
PART 3
MAT.: STEEL
OPERATION | MACHINE | RATED CAPACITY
HEAD | HEADER | 175/MIN.
ROLL THRD | THRD ROLLER | 100/MIN.
KNURL | THRD ROLLER | 100/MIN.
*10-32 N.F. 2 THR'D P.D. 1670 - 1697
KNURL APP. O.D. 13/64
DO NOT SCALE
PART 6
MAT.: STEEL, NICKLE PLATED
OPERATION | MACHINE | RATED CAPACITY
HEAD | HEADER | 175/MIN.
KNURL | THR'D ROLLER | 100/MIN.
1/64 x 45°
DO NOT SCALE
KNURL 1/8 APP. DIA.

COURTESY OF THE LAMSON & SESSIONS CO. AND THE CENTRAL SCREW CO.

insert are not required for the functioning of the part, the section can be partially cut out and bent over to provide anchorage. This method is illustrated in Fig. 12. If metal inserts must be thick, bosses can be extruded and slightly flared to act as satisfactory anchorage. Anchorage may also be obtained by spot-welding lugs to the underside of the insert.

d. *Drawn shell-type inserts*—Where a minimum wall thickness of plastic is specified and an insert of this type is used, extreme caution must be exercised to provide



13 and 14—An unsatisfactory and a fair design for tubular insert anchorage in thin wall plastic parts. 15—The best grip is obtained by flaring insert slightly inward

proper anchorage. Figure 13 shows an anchorage which is unsatisfactory because it allows insufficient wall thickness of plastic to avoid cracking. Figure 14 shows an insert which is fair in design and could be used to good advantage. In an insert of this type, the plastic has a chance to slide over the insert. However, to provide the best possible anchorage, the insert is flared in slightly (Fig. 15). In this design, the plastic actually has a chance to anchor the insert and to creep while shrinking.

e. *Drawn pin-type insert*—Very often an insert of this type is molded into a plastic and then countersunk after molding as illustrated in Fig. 16. Although there is a slight bead provided as an undercut for anchorage, on an insert of this type it is entirely insufficient to hold the insert properly. Wherever possible when an insert of this type is used, piercing pins should be provided so that the insert can be pierced during the molding operation and the necessary countersink molded into the plastic. During this piercing operation the insert is flared out to provide proper anchorage. See Fig. 17.

Figure 18 shows a drawn-type pin with an open end. Partial anchorage is obtained by shearing and folding two segments during the molding operation. Floating pressure-type piercing pins are recommended to minimize the flow of plastic into the insert.

f. *Drawn shell threaded inserts*—As illustrated in Fig. 19, these inserts are often used on large molded parts where it is not necessary to have 75 percent of thread, or where insert space is limited. Because the shell is usually thin, approximately 50 percent of the thread depth is obtained. The four flared lugs provide a satisfactory anchorage in every respect. It is impossible to provide sealing points on an insert of this type and hence, a flow of material into the thread must be expected. Tapping after molding is recommended for most satisfactory results.

g. *Intricate inserts*—An intricate insert is shown in Fig. 20. Considerable difficulty with cracking of plastic was encountered until aluminum inserts were selected. Actually there were two factors in favor of aluminum, its coefficient of expansion and the ability of aluminum to give or spring slightly when the plastic was shrinking.

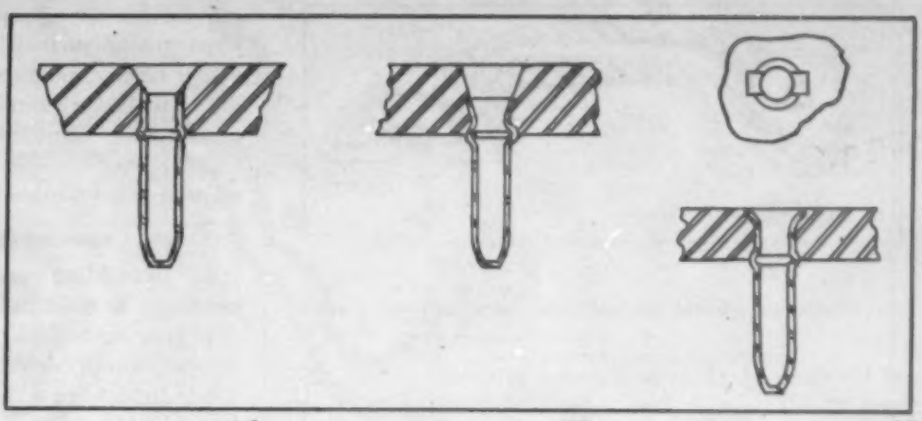
h. *Large surface inserts*—It is often necessary to mold one or more large surface inserts on one side of the plastic as illustrated in Fig. 21. Inserts of these types cause non-uniform shrinkage of the plastic and considerable warpage. Regardless of the type or method of shrinkage or cooling fixtures, it is certain that surface *A* will be convex and *B* concave after the piece is allowed to cool and age. If a flat surface is required, the surface must be machined. Best results will be obtained when the parts are allowed to age before machining or, where possible, baked in an oven for at least 72 hr. at suitable temperatures.

i. *Large inserts with a minimum of wall thickness of material*—Where a minimum thickness of plastic is allowed around a large insert and the part calls for thermosetting material, a special non-cracking type will generally have to be used. Extreme care must be taken in the design of the insert to avoid sharp corners or other features which might create local stresses.

j. *Irregular shaped inserts*—These inserts cause the greatest difficulty. Figure 22 shows a U-shaped insert approximately $1^1/_2$ in. long, on which two rib projections are required above the plastic. From the standpoint of economy in forming this insert and loading it into the mold, it can be made in one piece. But difficulty will be experienced with cracking of the plastic. It would be more economical in the long run to make two separate inserts, as shown in Fig. 23.

If electrical contact is required, a wire can be fastened between the two inserts; or if a more solid connection is desired, the insert can be made solid with cut-out slots, as shown in Fig. 24. Provision must be made in one half of the mold to prevent these slots from being filled with plastic. When these slots are open, there will be a slight give in the insert when the plastic shrinks. This will reduce or eliminate the possibility of cracking of the plastic.

When a long bar-type insert is used, it is always



16, 17, 18—Three different methods for anchoring drawn pin-type inserts in the molded plastic articles

16 17 18

advisable to provide an anchorage in the middle of the bar by means of grooves or slots, or through the use of a coarse diamond knurl for round bars (see paragraph IVa). The center anchorage will allow the plastic to creep along the surface of the insert while it is shrinking toward the center. If additional anchorage is desired on round bars, the ends can be knurled with straight knurl (Fig. 25) and still retain the creeping action. Where dimensional accuracy is required, full allowance for shrinkage should be made. If the part is of cylindrical shape circular rings can be provided for anchorage instead of a knurl. These rings will give satisfactory anchorage and at the same time allow the plastic to creep uniformly around the periphery of the insert. When a knurl is used on a piece of this type and the plastic begins to shrink, it has a tendency to climb up on the knurl, producing stress and causing it to crack.

Inserts should be preheated (above the mold temperature if possible) prior to molding. This will allow the maximum expansion and improve the flow and cure of the material. On thermoplastic materials, preheating will eliminate the possibilities of weld marks which often result in cracking of the plastic after molding.

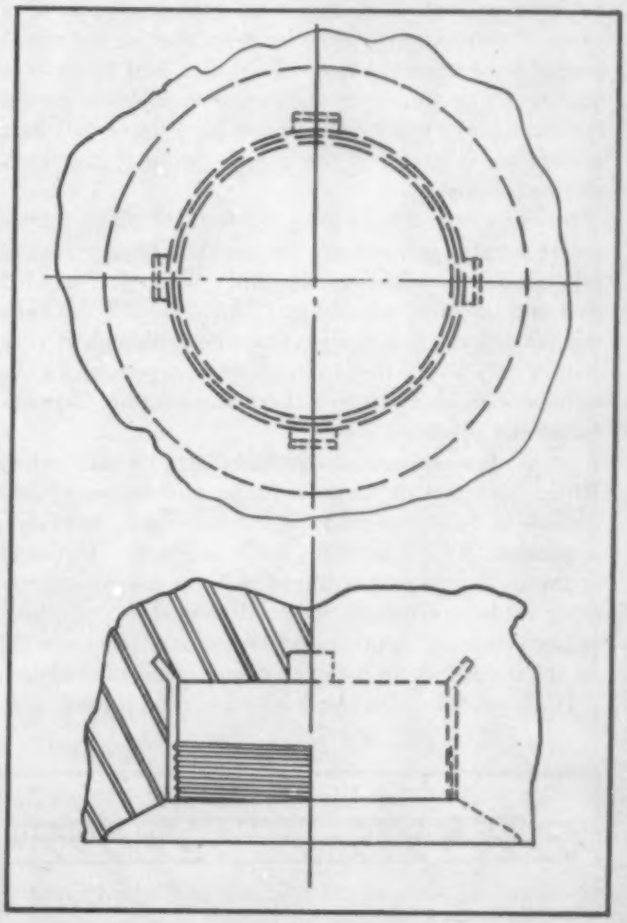
XIII. Non-metallic inserts

a. Inserts of various materials are used successfully. Wood inserts, for example, are used as a core especially for thermoplastic materials and mainly in compression molding. The use of wood inserts in parts such as doorknobs saves material and shortens the molding cycle.

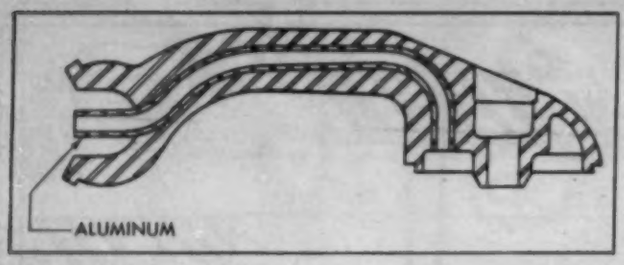
b. Glass inserts are being successfully molded into thermoplastics by injection and into thermosetting materials by transfer. Difficulties can be reduced during the initial engineering of mold design. The most difficult problems are caused by the non-uniformity of contours and dimensions. Glass, being of brittle nature, does not lend itself to the application of full clamping pressures during molding without the possibilities of breakage. It is necessary to provide a cushion by means of springs or rubber to compensate for the normal irregularities. In some cases, paper is glued to the surface of glass to provide additional cushion and also protect the surface from scratching.

Locating the insert in the mold is difficult. Figure 26 illustrates a sleeve-type ejector method. The inside sleeve diameter is of the same size as the glass insert. Location of the insert is obtained by placing the insert inside of the ejector sleeve when it is protruding in ejected position. Figure 27 illustrates a step-molded part. One of the steps must be of the same diameter as the outside diameter of the insert. A sleeve-type ejector is used on this step. Location of the insert is obtained by the inside of the sleeve.

It is recommended that all but a small outer surface



19—Drawn shell inserts are anchored with 4 flared tabs. This insert, plan view shown at the top, section view at the bottom, provides only 50 percent of the thread depth



20—Aluminum should be used for very intricate inserts

of the pressure plugs be recessed as shown in Figs. 26 and 27. This will allow a small steel surface contact with the insert and will also minimize the possibilities of breakage.

c. Porcelain in tubular form is used as an arc-protecting material. In some cases, a porcelain tube is placed over a wire insert and allowed to protrude from the plastic. In case of arcing, the arc is on the porcelain instead of the plastic. Hard rubber and melamine inserts are used to prevent tracking, especially when revolving contacts are used.

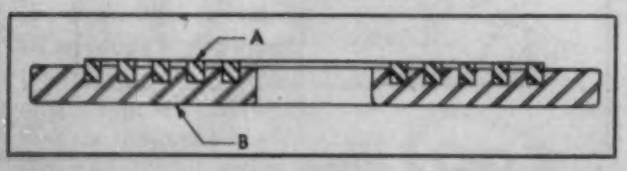
XIV. Leakproof inserts

a. In many applications, parts made of plastic are required to withstand higher internal pressures. Because of numerous variables between plastics and metal inserts, because of the types of plastics, and because of inadequate or improper anchorage in molding inserts into such parts, it is usually impossible to have the insert remain airtight within the plastic—even under minimum pressures.

b. To retain a tight joint between the plastic and a metal insert it is necessary to provide a flexible wall of other material between the two. When the molded part and the insert expand and contract under the various conditions, this flexible material, although it consists of only a very thin coating, will compensate for the difference in coefficient of thermal expansion between metal and plastic.

c. A few successful methods are recommended. Knurl the insert the same as for normal anchorage and provide at least two grooves, not necessarily too large, approximately $^1/_{32}$ in. wide, 0.020 in. deep. The head or the anchorage part is dipped in Neoprene, Vinylite or other rubbery synthetic materials, and then oven dried before using. This process will supply sufficient coating on the insert to give it the necessary cushioning action.

It is possible also, especially on round inserts, to provide a groove in the anchorage head of the insert large enough so that a Neoprene washer can be used. Under normal molding conditions, the washer will produce satisfactory results. On some applications, a retaining groove is molded or machined between the insert and the plastic. The groove is filled with Glyptal and allowed to dry at room temperature or is oven baked.

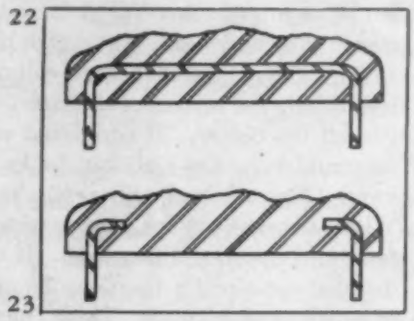


21—Machining of a part subsequent to molding is necessary when inserts of this type are used, particularly when absolute flatness is required in the finished molded plastic piece

XV. Special inserts for reinforcement

a. In molding various parts from plastics, it is often necessary to mold in inserts for reinforcements to provide greater strength, rigidity, safety (as in automobile steering wheels) or greater dimensional accuracy.

b. In molding a thermoplastic housing, for example, instead of molding a thick wall to obtain rigidity, a sheet metal reinforcement can be molded on the inside of the housing. This will not only produce greater rigidity with a minimum of wall thickness but it will also assist in maintaining a better dimensional accuracy. Various materials can be used as reinforcement—molding board or Rogersboard, laminated phenolics, perforated metal, metal screens.



22 and 23—The insert design shown in Fig. 22 is not as practical as the 2-part insert shown in Fig. 23

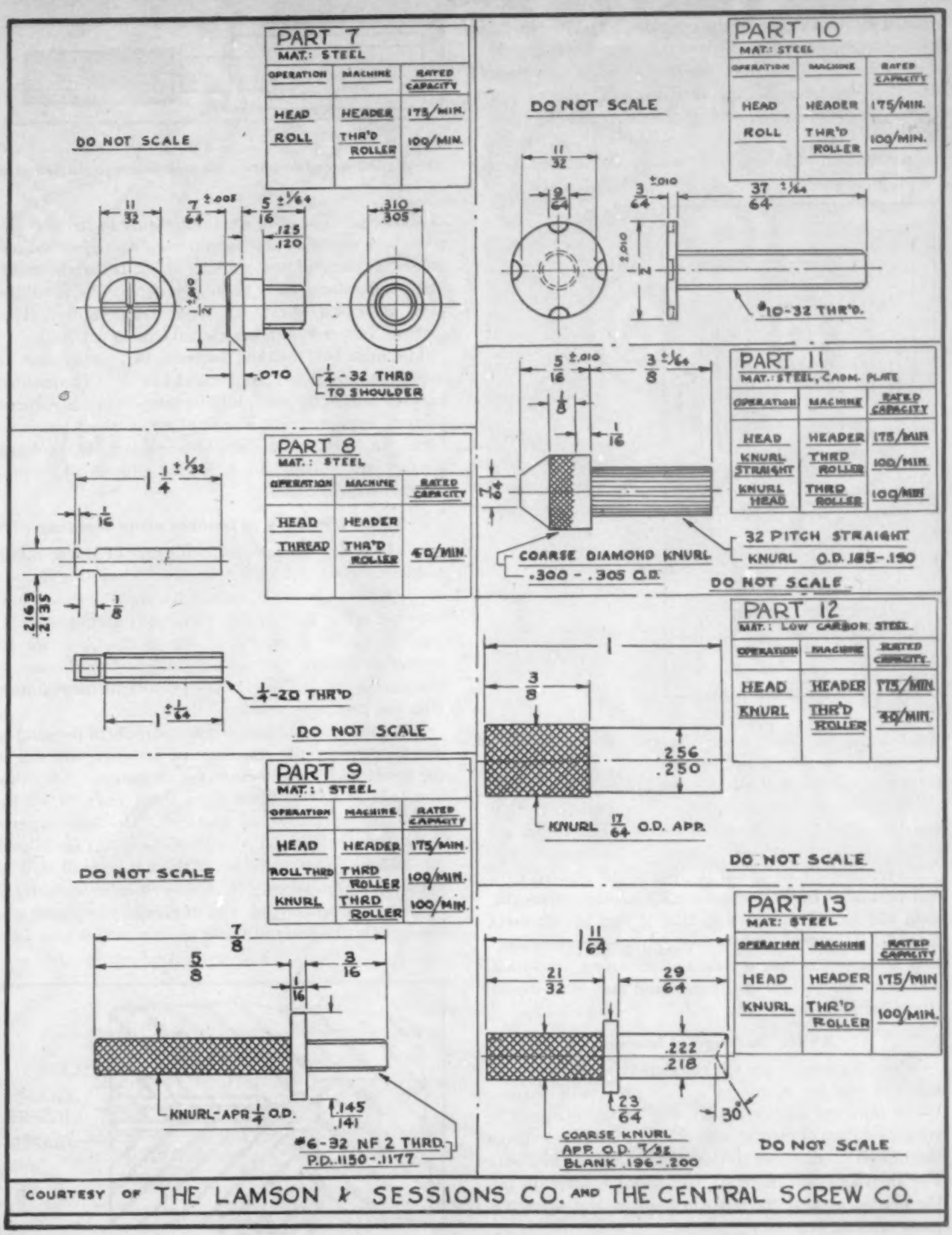
XVI. Preparation of inserts before molding

a. Considerable significance should be attached to the cleaning or washing of inserts prior to molding, especially a screw machine product. If inserts are improperly washed, even though they appear clean, there may be some loose metal chips hanging on to the threads, or some fine metal dust in the knurls. This is often rolled into the surface by the process of knurling and, while not easily washed off, will be loosened by the flow of the plastic. These metal chips may flow up to the surface and impair the appearance of the molded part. The most serious difficulty, however, is in electrical applications where a small particle or slight metal dust will cause a total breakdown electrically. Grease and oil are also detrimental to molded parts from the standpoint of appearance and should be washed off.

b. Cleaning processes are divided into three types:

1. Mechanical, including hand polishing, tumbling, shot or sandblasting, solvent degreasing, alkali washing.
2. Chemical, such as removal of iron rust and silver tarnish by an acid bath.
3. Use of electrolytic cleaners.

Oil and machining chips can best be removed by a



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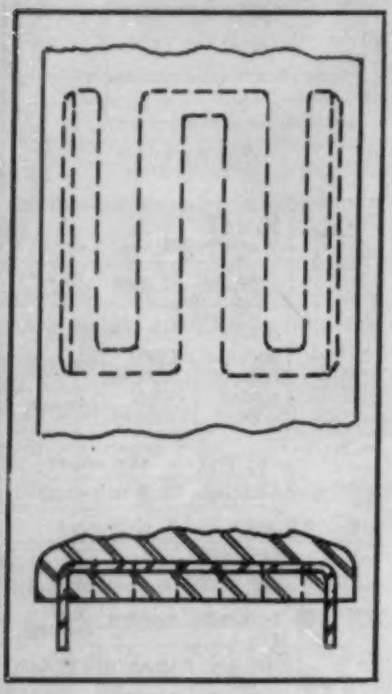
well-stirred alkali bath followed by a rinse with hot water, except where the nature of the metal, such as aluminum, rules out the alkali in favor of degreasing with solvent.

In many cases a reasonable amount of tarnish can do no harm but where the function or the appearance of the piece demands chemically clean inserts, an acid dip is necessary. For brass and bronze, a mixture of nitric and sulfuric acids or nitric alone is commonly used.

Silver tarnish can be removed with nitric acid or a

diluted solution of one of the cyanides. Oakite No. 32 has been found to be an efficient remover of iron rust.

c. *Cleaning flash from inserts*—Most of the flash difficulty can be avoided in the design of the part and the insert by providing sealing points so that the flow of plastic is cut off or at least minimized. However, even with the best design there will be some material on



24—Cut - out slots in an insert reduce the tendency of the plastic materials to crack

the inserts, especially when the mold wears or close tolerance on inserts is not maintained. When the inserts are plated and polished, there is a minimum possibility that flash will adhere. Several methods are recommended to minimize this condition. Lubricate the insert prior to molding with wax, soap, grease or oil.

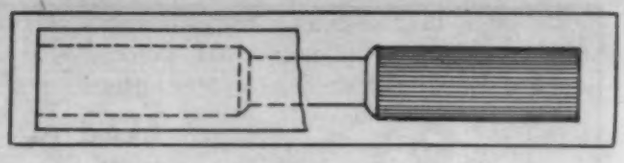
To remove the flash, cut it close to the molded part and peel off. In most cases a mild solution of caustic soda will loosen the flash so that it can be easily removed. This method, however, requires extreme caution because too long a time or too strong a solution will harm the surface of the part and may even loosen the insert in its anchorage.

XVII. Salvage of Inserts

When the inserts are the through type, they can be knocked out by means of a foot press and fixture. When they are anchored part way in the material, a strong solution of caustic soda will loosen the inserts on thermosetting material so that they can be picked out. For thermoplastic material, use suitable solvents for the plastic, or heat the parts in an oven and when the parts are soft, pull out the inserts.

XVIII. Relieving molding insert stresses

a. Considerable stresses are set up in molded parts of irregular design, such as those with thin and thick sections, and especially parts with metal inserts. The best method to relieve stresses is to allow the part to



25—A good way of anchoring bar-type inserts to molded parts

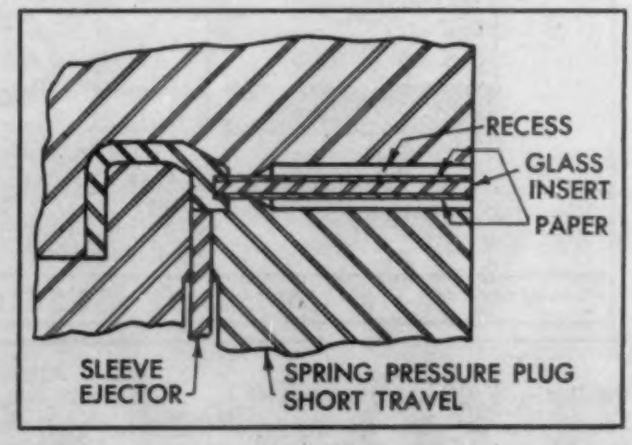
cool slowly. The ideal condition would be to carry the parts on a conveyor through an oven which has various stages of temperatures, starting at 50° below the molding temperature, then gradually decreasing until the part is cooled down to room temperature. This method, however, requires special equipment.

The next best method requires two ovens, one at approximately 225° F. and one at 150° F. The molded part remains in the oven until its temperature is reduced to oven temperature. The final step is room temperature. In case of thermoplastic materials, molding stresses are relieved by a baking process at recommended temperatures.

XIX. Pressing in inserts after molding

a. It is often economical to press in inserts after molding. Best results are obtained when this is done at the press. In most cases, a fixture is designed and mounted in a small arbor press or punch press. I there are several inserts in the part, they can be pressed in in one operation. The best anchorage is obtained when the inserts are pressed in immediately after the part is ejected from the mold.

When designing a mold for the purpose of pressing in inserts, consider the shrinkage of material, the size of the insert and the allowance for anchorage. On small inserts it is safe to allow from 0.001 in. to 0.002 in. above the shrinkage of material. On large inserts however, as little as 50 percent of the shrinkage is used for anchorage, specially when there is a small wall of material. For example, if an insert 4 in. in diameter is to be molded with $^1/_4$ in. wall of plastic, the plastic will crack. On the basis of 0.008 (*Please turn to page 192*)



26—When glass inserts are installed in plastic parts, the mold must be especially designed for the purpose

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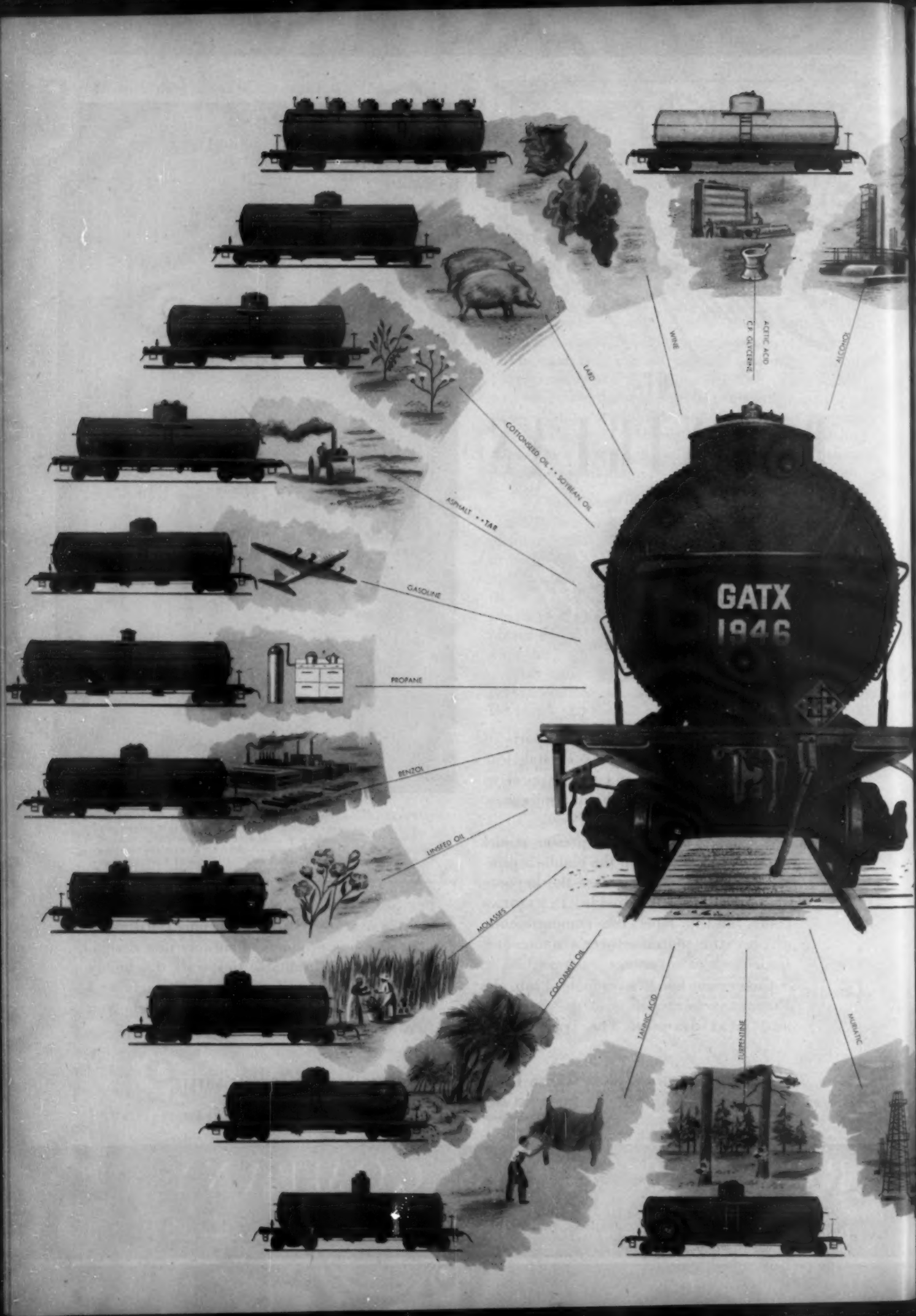
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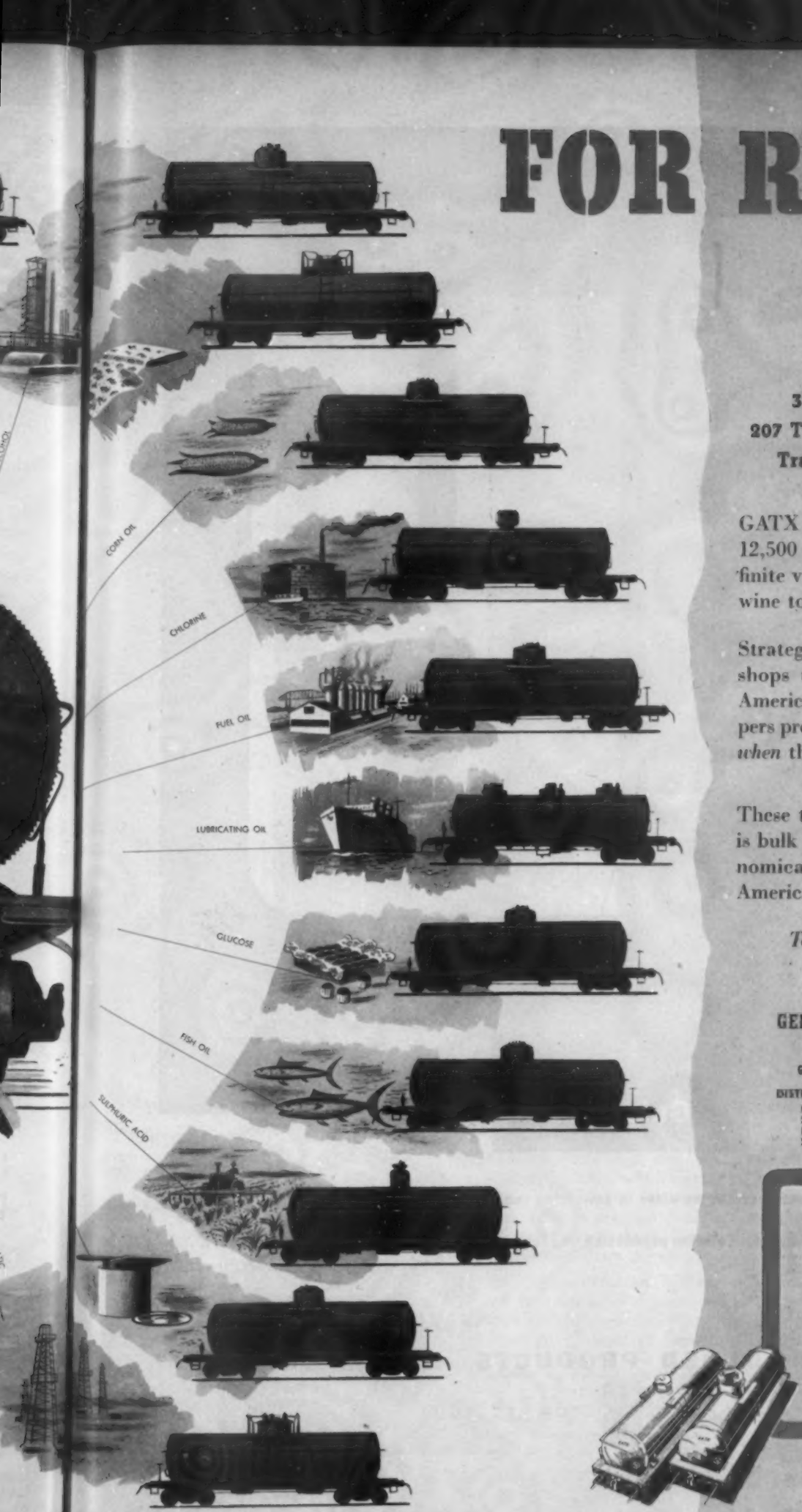

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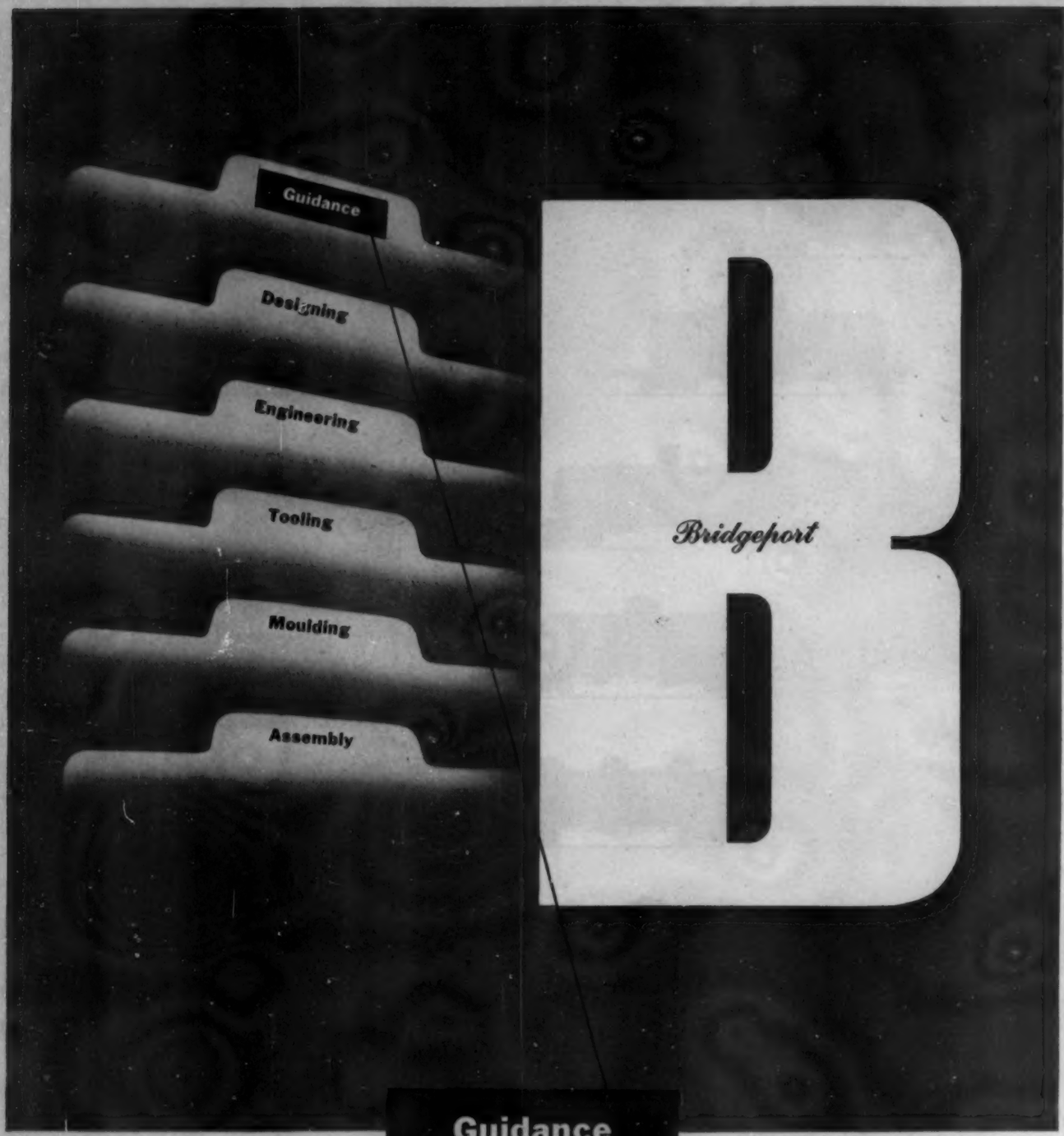

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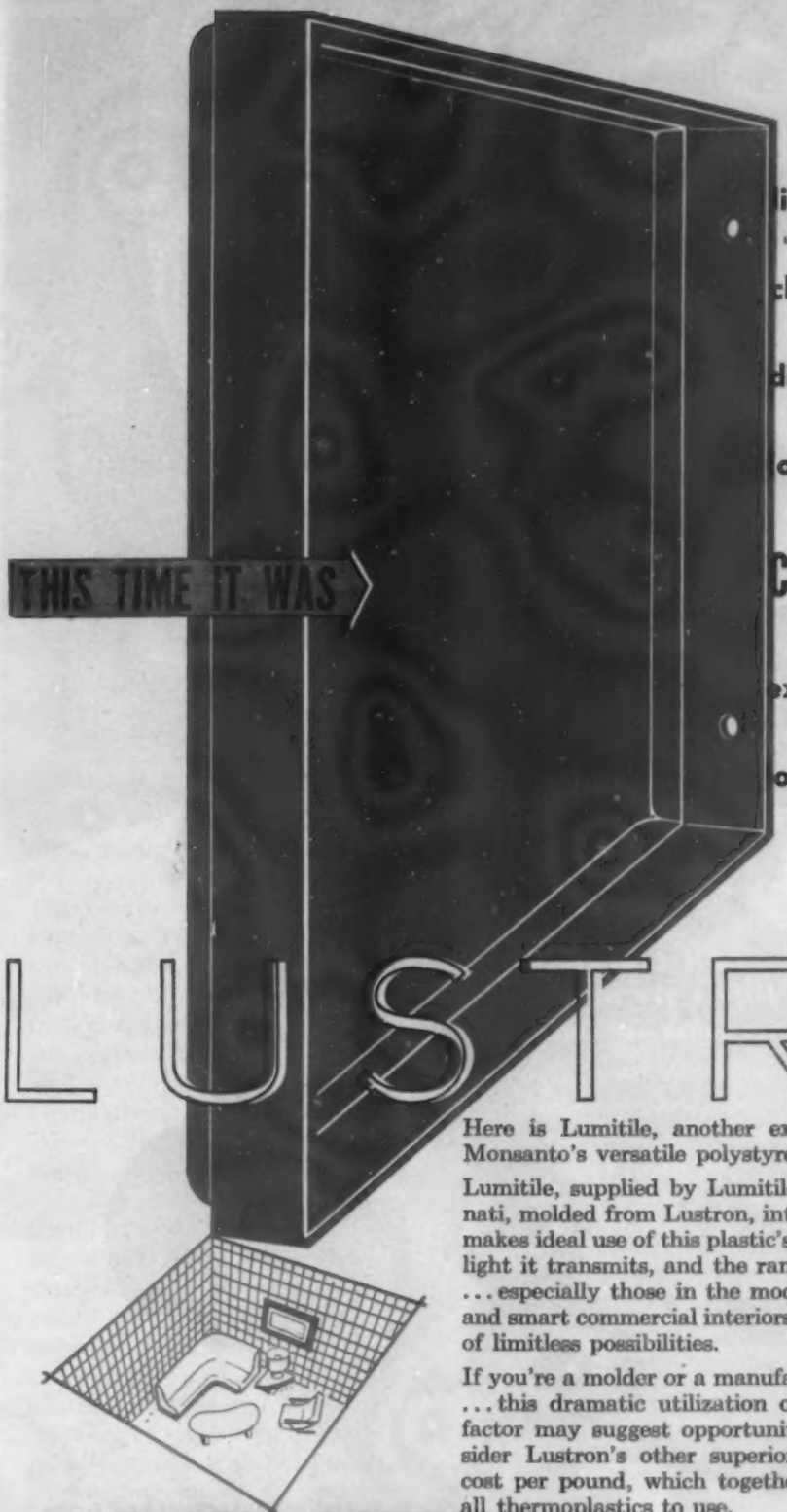

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Advances in plastics during 1945

by G. M. KLINE*

So much has happened during 1945: total war, then VE-Day, atomic bomb, VJ-Day, reconversion. This certainly adds up to the keynote of the year—transition. This annual review of advances in plastics is more than ever before an inventory of the industry's potentialities rather than merely a record of accomplishments.

Materials

The parade of new materials from the research laboratories to the market can be expected to begin in 1946. Because of wartime restrictions on new plant facilities and preoccupation of engineering staffs with capacity production of established products, there was only one strictly newcomer in the plastics family during 1945. The commercial production of cellulose propionate[1] was announced late in the year. This plastic has become available at a competitive price as a result of the development of a new process for making propionic acid from cheap hydrocarbons obtained from natural gases and petroleum. Its uses in the form of molded products, sheets and films will parallel those of other cellulosic plastics. Lower moisture sensitivity and a greater inherent plasticity endow this material with better dimensional stability than cellulose acetate plastic.

Important industrial developments in German plastics during the war years were disclosed to the American industry as a result of investigations by technical teams that followed the Allied armies into Germany. One report[2] described several new types of plastics which have not been manufactured in the United States; namely, polyurethanes, polyvinyl ethers and polyethyleneimine, as well as many different types of copolymers of vinyl chloride, styrene and acrylic esters. Other reports revealed the method of manufacture of polyvinylpyrrolidone,[3] a polymer with the unique property of solubility in both water and organic solvents, and a synthesis of acrylic derivatives[4] directly from acetylene, carbon monoxide and compounds with labile hydrogen atoms. These publications indicate that the reports of the investigators will be a fruitful source of new information on plastics during 1946.

The literature on the silicone polymers continued to grow. Silicone rubber gaskets[5, 6] are used on searchlights and the turbosuperchargers in B-29 bombers. Enamels[5, 7] made from silicone resins should be advantageous for baked coatings on ranges, radiators, heat exhaust pipes and stacks. Treatment of textiles, mirrors, windshields, wallpaper, etc., with organosilicon compounds renders their surfaces water repellent.[8] Preparation of the silicon derivatives by direct synthesis was reported.[9] Several comprehensive reviews of developments in this field were published.[10–12]

The outstanding qualities of polyethylene as a high-frequency dielectric were stressed in a detailed engineering report.[16] Its physical and chemical properties were reviewed by several authors.[17–19] A recent development is the production of polyethylene film[20] for packaging the anti-malarial mepacrine. Its water and fungal resistance, flexibility over a wide temperature range and heat sealability are important attributes.

There were several significant announcements regarding improved transparent plastics for optical purposes. Information regarding the manufacture of lenses for military cameras and sighting equipment was released from its wartime secret status.[21] These plastic lenses were made from polystyrene and cyclohexyl methacrylate. A new allyl ester resin[22] was described

The year 1945 saw the development of many interesting applications for melamine. Among these were decorative sheets which could be applied to laminates at pressures of 250 p.s.i.

PHOTO, COURTESY DETROIT WAX PAPER CO.

* Chief, Plastics Section, National Bureau of Standards.

which provides a thermosetting plastic of excellent clarity and a refractive index of 1.5483. Shrinkage on polymerization is very low for this material, ranging from 3.25 to 4 percent. Improved techniques for molding transparent methacrylate parts were discussed[23] and two coatings for protecting methacrylate windshield sheet stock were described.[24, 25]

Developments in cellulosic plastics included a flame-resistant molding composition,[26] thermoplastic laminates[27] and carboxymethyl cellulose.[28] A general review of cellulosic molding compounds was published.[29]

Melamine resins were used in a number of new and interesting applications. Decorative sheets which could be applied to laminates at pressures as low as 250 p.s.i. were manufactured.[30] Panel boards prepared by bonding glass fabric with melamine resin were developed to provide Navy ships with a fire and arc resistant laminate of high impact strength.[31] A rag-filled melamine molding compound was used to provide similar qualities in electrical insulating parts used in mining operations.[32]

Phenolic casting resins[33,34] proved to be satisfactory in many applications, including plating shields, foundry patterns, forming dies and holding fixtures. A general background of methods and materials used in processing phenolic molding compounds was contributed by one author.[35] Naturally occurring phenolic compounds present in lignite received consideration as a source of insulating materials.[36] Another source of complex phenolic products from natural sources is lignin which has been investigated very extensively as a raw material for the manufacture of plastics.[37, 38] Lignocelluloses occurring in agricultural wastes have also been used in the preparation of molding compounds.[39, 40]

Wood pulp as a reinforcing filler in the formulation of tough plastics has received considerable attention.[41–46] Wood itself, with its cellular structure relatively undisturbed, has more recently become an important addition to the reinforcing elements used in the plastics field.[46,47] In the impregnation and molding of solid wood to final form for use as brush backs, knife handles, knobs, etc., the inherent natural beauty of the wood is retained, and resistance to water, acids, alkalies and heat is imparted. The laminated type of molded wood has been widely employed for fan blades, airplane propellers and the like.[48, 49] Other types of reinforcement used in the manufacture of laminates were the subject of various investigations; these included paper,[50–52] cotton fabrics[53] and glass fabrics.[54,55]

There was marked activity during the year in the development of synthetic core materials for sandwich-type structures.[56–58] Interest in this field was stimulated by the results of tests by the Army Air Forces on a sandwich fuselage structure which proved to be 50 percent stronger than the standard metal section.[59] In addition to aircraft parts these plastic foams and sandwich materials have possible outlets in low-weight furniture, refrigerators, stoves and insulation.[60]

Significant reports were published concerning resins from cashew nut shell liquid,[61] rosin esters,[62] polystyrene,[63] polyamides,[64] alkyds,[65] unsaturated polyesters,[66] vinyl elastomers[67] and keratin-modified phenolic plastics.[68] A comprehensive booklet on sugar[69] as a raw material for the manufacture of plastics was issued. Resin-modified starches for coating paper were observed to have improved resistance to water and better adhesiveness.[70] Four articles on plasticizers[71–74] discussed recent additions to the commercially available products of this type; German progress in this field was revealed in a release[3] of the Office of the Publication Board, Department of Commerce.

The Society of the Plastics Industry made an important contribution to the adoption of simple terminology and recognized standards for plastics by publishing a classification of molding materials.[75] Aimed to provide data comparable to those which have been available for wood, metals and other engineering materials, the classification presents in chart form information pertaining to the mechanical, electrical, optical, thermal, chemical and aging properties of standard molding compounds.

PHOTO, COURTESY E. L. GOURRAND, INC.

The turret dome of a Navy PBM airplane is formed of a transparent acrylic. Here the upper half of the snap-back die is about to be lifted for removal of the dome

Molding and fabricating

One topic which predominated in discussions of improved techniques in this phase of plastics activity was low-pressure molding. In one review of this subject the author[76] defined low-pressure molding as the technique of forming flat, simple- or compound-curved surfaces, in material capable of permanent deformation, by means of pressures under 500 p.s.i., with particular emphasis on pressures below 100 p.s.i. The art was divided into four classifications—laminating,[77–79] gluing to contour, plastic forming and resin curing to contour. The third class is apparently broad enough to include forming of methacrylate enclosures,[80, 81] cellulose plastic containers,[82] and shaping vulcanized fibre parts.[83]

The John Wesley Hyatt Award for 1944 was presented to W. I. Beach[84] for his work on the postforming of laminates which provided critically needed parts for the aircraft industry with savings in man hours, weight

and costs. Further advances in this fabrication method were reported.[85]

Improvements in equipment and methods were described for the conventional molding processes—namely, compression,[86, 87] transfer,[88, 89] injection[90,91] and extrusion.[92, 93] The molding of hollow articles by blowing a plastic material into the desired shape has undergone radical changes and opened many possible markets for plastics in the container and ornament trades.[94]

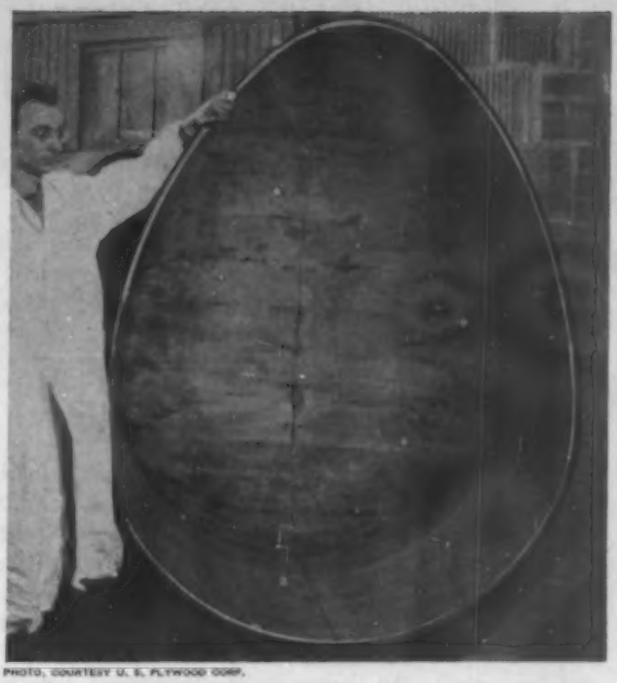
Electronic preheating[95–97] continued to gain in importance as an adjunct to compression molding, being used to process approximately 40 percent of phenolic molding compounds, according to a reliable estimate. Modern heater design[98] on injection presses were reviewed, including current efforts to adapt radio-frequency heating to this equipment. A special electrically heated steam generator to service individual presses was placed on the market.[99] Improved equipment for heat-sealing highly oriented thermoplastic films which have a high softening point was described.[100] An innovation in heating thermoplastics for welding parts together was accomplished by rubbing the two pieces together at high surface speeds (6000 r.p.m. for a 1-in. diam. methacrylate rod) and quickly applying a pressure of about 300 p.s.i. for a few seconds. The method has proved to be satisfactory for uniting lens components, sealing compasses and attaching knobs to metal or wood inserts.[101]

Special problems relating to molds[102–107] and preforming[108, 109] were discussed by various authors. A new type of fastener for attaching laminates together without marring the surfaces was introduced.[110]

Methods for spraying plastics on the various materials were reviewed.[111, 112] A simple method for applying calibration scales and dial faces to precision instruments was disclosed.[113] Further information was published on the techniques involved in applying metal coatings to plastics.[114]

Applications

The last year of World War II witnessed numerous additions to the roster of plastic parts serving our armed forces. Many of these had been in use earlier in the war and were released from secrecy during 1945. Notable among these were the proximity fuse,[115] rockets,[116] M-74 incendiary bombs,[117] plastic armor for vests and curtains to provide protection against flak,[118] the T-44 frangible bullet[119] and the No. 77 smoke grenade.[120] There were no disclosures regarding plastic parts used in the construction of the atomic bomb. A comprehensive account was given of the important function of plastic radomes in radar.[121] Plastics were also used for insulation on radio equipment,[122, 123] ogives for navy projectiles,[124] impregnation of map paper to produce high wet-strength paper,[125, 126] machete sheaths[127], desalter bags[128] and melamine trays and tableware.[129, 130] A comprehensive survey recorded developments in plastic materials and applications in Great Britain during the war.[131]



PHOTO, COURTESY U. S. PLYWOOD CORP.

A representative female low-pressure molding form

The aircraft industry continued to utilize plastics in a wide range of applications. Further advances were made in the development of materials for structural purposes.[132–136] Specific uses included air ducts,[137] interior decoration,[138] hydraulic systems,[139] propeller equipment[140] and forming dies.[141] The versatility of plastics was indicated in articles pertaining to their use in gliders,[142] helicopters[143] and small airplanes.[144] The status of wood as a construction material for aircraft[144a] is of interest because of the predominant role of synthetic resins as bonding and coating agents.

Automotive applications of plastics were summarized by several authors.[145–147] The trend to resin-bonded plywood in small boat construction was highlighted during the year.[148–150] The building industry is also expecting to use large quantities of this material to alleviate housing shortages.[151, 152]

The medical profession is absorbing more and more plastics each year for instruments,[153–155] prostheses[156–158] and gauzes.[159] The shoe industry is now taking millions of pairs of plastic soles annually.[160–162] Many revolutionary changes in textiles are resulting from the use of plastics for synthetic fibers,[164–167] impregnation and surface treatments of fibers[168–171] and film coatings on fabrics.[172–175] The packaging industry is exploring the peacetime possibilities for the many types of plastic films developed during the war.[176–179]

Protective coatings as a major field of application for synthetic resins were the subject of numerous reports.[180–184] A review was published concerning the uses of plastics by the motion picture industry.[185]

Industrial utilization of ion-exchange resins on an expanding scale was indicated by articles pertaining to their roles in purification of food products,[186] recovery of metals[187] and manufacture of drugs.[188] Other note-

worthy applications of plastics described during the year included resin-bonded magnets,[189] tank linings,[190] compasses,[191–193] brake linings,[194] signs,[195, 196] luminescent fixtures and dials,[197] irrigation piping,[198] bottles,[199] battery separators[200] and resin-bonded sand cores for foundry use.[201]

Adhesives

Surveys of the fundamentals of adhesion,[202] and the important functions of resins in providing an efficient means for attaching wood,[203–205] metals,[206–210] plastics,[211] glass[212] and other materials into composite structures focussed attention upon this growing market for the industry's products.[213–216]

Properties, testing, specifications

Three papers on plastics were presented at the annual meeting of the Rubber and Plastics Division of the American Society of Mechanical Engineers.[217–219] This group also sponsored papers relating to the mechanical strength,[220, 221] creep[222] and permanence[223] properties of plastics. Other contributions discussed laminates,[224, 225] adhesives,[226] resin-cement mixtures[227] and engineering developments.[228] Important aspects of resin-wood combinations were reported.[229–231]

The American Society for Testing Materials was unable to hold its annual meeting because of wartime restrictions. Four papers relating to dimensional stability,[232] specific gravity determination,[233] fatigue properties of paper-base laminate[234] and mechanical properties of cellulosic plastics[235] were presented by title. Papers published by the Society concerned investigations of compressive,[236] flexural,[237, 238] impact,[239, 240] hardness,[241] creep,[242] flow[243, 244] and flame-resisting[245] properties of plastics. A.S.T.M. Committee D-20 on Plastics completed action on a specification for cast allyl plastics and four new methods of testing pertaining to deformation under load, flow of thermoplastics, determination of ammonia in phenolic molding materials and determination of acetyl and butyral in cellulose acetate butyrate.[246]

Developments in synthetic electrical insulation were reviewed in a report sponsored by the National Research Council.[247] Investigations of performance properties in other fields included bearings,[248] packaging,[249, 250] laminates[251, 252] and synthetic fibers.[253] Important contributions were made to our knowledge of the mechanical,[254–257] thermal,[258, 259] electrical[260] and aging[261–263] properties of plastics.

Improved testing procedures involving new instruments and techniques were described during the year. X-ray,[264] infrared,[265] microscopic[266, 267] and chemical[268, 269] methods were used to identify plastic materials. Ultrasonics proved to be a new research tool of importance to the high polymer field.[270–272] Optical methods for evaluating the properties of plastics were studied by several investigators.[273, 274] Other reports concerned the measurement of impact strength,[275, 276] plasticity,[277] permeability to water vapor[278, 279] and carbon dioxide[280] and surface smoothness.[281] Equipment for preparing test specimens of laminates at a considerable saving in man hours was described.[282] Growing interest in the testing of plastic consumer goods was foreshadowed by five papers relating to examination of finished moldings,[283] closures,[284] optical elements,[285] bearings,[286] insulated wiring, bullet-resisting glass and fire-extinguishing equipment.[287]

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(Please turn to page 196)

Polyvinyl alcohol in Germany*

by G. M. KLINE†

INDUSTRIAL practice in Germany in manufacture and utilization of polyvinyl alcohol is summarized in this report. The principal producer of this material was the Dr. Alexander Wacker Ges. fur Elektrochemische Industrie G.m.b.H. at Burghausen where approximately 30 tons per month were made. The selling price to customers who used it in adhesives, tubing and textile sizing agents was 5.6 to 7.0 RM./kg. There was also some production by the I. G. Farbenindustrie A.-G. at the Hoechst plant, but their output was used primarily for further processing into polyvinyl acetals.

The Wacker plant used two types of polyvinyl acetate in the manufacture of polyvinyl alcohol—Vinnapas B, a low-viscosity polymer melting at 120 to 130° C., and Vinnapas U, an infusible polymer. The B type gives a polyvinyl alcohol which is more soluble in water. A typical grade designation is U.K.B. 100/100; the letters stand for Ungeestered Knieder B-type and the numbers mean that polyvinyl acetate of 100 seconds viscosity, determined by the Hercules falling-ball method using a 20 percent solution in ethyl acetate, was de-esterified to yield a polyvinyl alcohol with a saponification number of one hundred.

Manufacture

Burghausen[1]—Twelve hundred kilograms of polyvinyl acetate are dissolved in 1000 liters of anhydrous methanol in a stainless steel Werner and Pfleiderer mixer by heating to 50° C. in 4 to 5 hours. The mass is cooled to 30 to 35° C., and 100 liters of a 1.5 percent solution of sodium methylate is added to start the saponification, followed by 150 to 250 liters more over a period of 4 hours. The mass becomes thinner and polyvinyl alcohol precipitates. The methanol and methyl acetate mixture is distilled from the mixer with a current of nitrogen through a separator with a bag to catch the polyvinyl alcohol. The condensate contains 45 percent methanol and 55 percent methyl acetate and is used as a lacquer solvent. The nitrogen is reused. The contents of the mixer are dropped out and may be used as is or milled. The resulting polyvinyl alcohol has an ash content of about 1 percent. For use for electrical purposes, the sodium acetate may be extracted with ethyl alcohol. The time required for a batch cycle is about 16 hours.

The more sodium methylate used, the lower is the saponification number (SN). For emulsifiers, material of SN 100 is made; for belting, SN 25. The drier the polyvinyl acetate, the less sodium methylate is required. Approximately 5 g. of sodium methylate are used per kilogram of polyvinyl acetate, the amount varying slightly according to the desired degree of saponification. The Wacker polyvinyl alcohols are marketed under the trade name Polyviol.

Hoechst[2,3]—Hydrolysis of polyvinyl acetate to polyvinyl alcohol is carried out here by both the acid and alkaline methods. In acid hydrolysis a 15 percent by weight solution of polyvinyl acetate (usually Grade 70) is prepared in a solvent mixture consisting of 60 percent methanol and 40 percent methyl acetate. Sulfuric acid is added (0.5 mol per 100 mols of polyvinyl acetate) and the mixture boiled under reflux for 24 hours. It is then cooled, centrifuged, washed with methanol, neutralized with dilute sodium carbonate solution, washed and dried in vacuo to produce a very fine powder. Excess solvent is recovered by distillation and returned to system.

The polyvinyl alcohol prepared by acid hydrolysis was used for blending in glues, lubricants and sizes. For the production of emulsions, polyvinyl alcohol was mixed with an equal weight of water containing the emulsifying agents. The emulsifying agent most commonly used was polyacrylic acid: 0.2, 0.5 or 1.0 percent based on the polyvinyl alcohol. Plasticizers most commonly used were tricresyl phosphate and dibutyl phthalate.

Polyvinyl alcohol prepared by alkaline hydrolysis is preferred for the production of polyvinyl acetals to be used in manufacture of safety glass in order to avoid discoloration due to sulfuric acid in product. In carrying out the alkaline hydrolysis, a 40 percent by weight solution of polyvinyl acetate is prepared in a solvent mixture consisting of 60 percent methanol and 40 percent methyl acetate. One to two mols of sodium hydroxide dissolved in methanol is added per 100 mols of polymer. The hydrolysis reaction is complete after boiling for 10 to 15 minutes. The extremely viscous solution of polyvinyl alcohol in methanol and methyl acetate is mixed with sufficient water to ultimately yield an 8 percent solution of polyvinyl alcohol in water and the organic solvents are removed by distillation. Kieselguhr is added and the 8 percent solu-

* Developments in the German plastics industry during the war have been thoroughly investigated by teams composed of technical representatives of the Ordnance Department, Quartermaster Corps, Chemical Warfare Service, Technical Intelligence Industrial Committee and other groups. The Department of Commerce is merely distributing this technical information which has come into its hands from captured German territory. This information should be made available to all United States citizens interested in it, but use of it by anyone must be and is at one's own risk in so far as the United States or foreign patent violations are concerned.

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tion subjected to a coarse filtration. Prior to the acetalization reaction the solution is filtered a second time on a Seitz filter to remove all foreign matter.

Fabrication of Polyviol[1]

The Wacker firm had developed extensive uses for polyvinyl alcohol in place of leather and rubber for antistatic driving belts, laces, hammers and the like. These applications had developed largely as the result of wartime shortages of materials, but they may be of interest in peacetime because of some outstanding advantages of the polyvinyl alcohol compared with the products which it replaced. The manufacture of these articles required the initial preparation of bands cast from an aqueous solution in various thicknesses depending upon the application.

To make the bands, a solution of 33 percent U.K.U. 100/25 polyvinyl alcohol in water is made at 100° C. The viscosity of this solution, as determined with a 10-mm.-diameter ball falling 10 in., is 2 min., 18 seconds. Plasticizer is then added; butylene glycol (35 parts per 100 of polyvinyl alcohol) was being used because of the nonavailability of glycerol, of which only 25 parts are required. For low temperature flexibility, the best plasticizer is 30 parts of a 50:50 mixture of the two. The solution is given a preliminary filtration through wire cloth and then is put through a filter press (20 cloths) at 100° C. It is stored at 90° C. for two days to get rid of air bubbles. It is then transferred by air or nitrogen pressure into the feed trough on a filming machine.

The plasticized polyvinyl alcohol solution feeds onto a continuous belt under a knife edge. An iron wire screen coated with polyvinyl acetate emulsion to a thickness of 3 mm. was being used, although copper wire was preferred. The belt makes a band 18 meters long and about 1 meter wide and runs at the rate of about 50 to 70 meters per hour. A thickness of about 0.1 mm. is applied at each revolution. The belt passes through a drier into which air at 90 to 110° C. is introduced at the upper end opposite the feed trough, passes countercurrent to the belt, and is exhausted at the lower portion of the same end. This provides a series of air temperatures, through which the belt passes, of 50 to 60° C., 90 to 110° C., 90 to 95° C., and 30 to 40° C. A band of $^3/_8$-in. thickness requires about 100 passages through the casting machine.

When the desired thickness has been obtained, the band is removed from the belt by cutting across its width, the edges are trimmed and the band is placed in an oven at 80° C. and 10 percent relative humidity. The time allowed for drying is 1 day per mm. of thickness. More rapid drying could be obtained with infrared lamps.

The dried band is passed through a series of stretching rolls heated at 80 to 90° C. Material for belts is stretched 2.5 to 4 times its original length; that for laces is stretched 4 to 6 times. A final profile roll is used when desired.

At this stage, material for certain types of belts is immersed in a 6-meter-deep bath of 60 percent phosphoric acid, heated with steam to 25 to 30° C. and stirred with air or nitrogen. The time of immersion is 20 min. per mm. of thickness. The bands are then stored in a room at 60 percent relative humidity for 1 to 2 months to allow the acid to diffuse into the band. This impregnation with phosphoric acid is better accomplished with a square profile on the surfaces of the band. The polyvinyl alcohol used to make these belts should not contain more than 1 percent sodium acetate; otherwise the sodium phosphate which is formed will bloom during the drying process. To reduce the water sensitivity of the belts, 1 percent potassium dichromate can be added to the phosphoric acid solution.

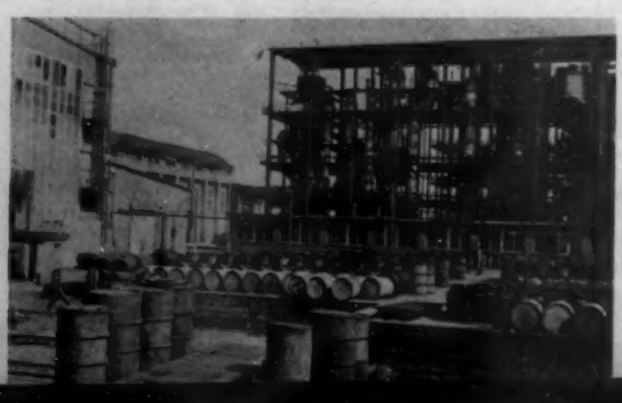
Driving belts—These belts are known by the trade name Drawerit. They are not recommended for running continuously, although this was done during the war. They are good for plants running on an 8-hr. day, particularly when air-conditioned. The Wacker plant has used up to 600 belts for a life of 2 years in their chemical plant. These belts were made with 25 parts of triethylene glycol per 100 parts of polyvinyl alcohol and contained 26 percent phosphoric acid. This composition had proved to be better than 45 parts butylene glycol and 24 percent phosphoric acid. The belts ordinarily tested are 2 mm. in thickness. However, they are made in thicknesses up to 8 to 9 mm. for 150 hp. motors.

To make an endless belt, the two ends of the band are skived, allowing about one-half the skive length required for leather belts. A mixture of 10 percent polyvinyl alcohol and 10 percent hydrochloric acid in water is applied, and the ends are clamped together without heating. The clamps are removed in about 15 minutes. The belts, themselves, are ready for tunning after 1 hour.

The comparative strengths of polyvinyl alcohol, polyamide and leather materials used for belting are

A section of the Salzach viewed as it flows past Burghausen

The acetaldehyde plant at Hoechst was virtually untouched



clearly indicated by the tabular data which follows:

Material	*Tensile strength*	*Elongation*
	kg./mm.²	*%*
Drawerit	21.3	37.5
Igamid (polyamide)	13.3	11
Leather (ox, transparent)	4.8	15

Laces—Polyvinyl alcohol laces are used as cords to bind leather belts, harness, mattresses, etc. Sixty tons of leather laces were used each year in Germany before the war. A Drawerit lace 0.6 mm. thick has a tensile strength of 60 kilograms. Leather of equivalent strength would be 1.5 mm. thick. Standard lace widths are 6 and 12 millimeters. Sbrinkage of the laces can be reduced by heating them under tension at 120° C. Laces are machine cut from stretched bands.

Hammers—Polyviol hammers replace lead, rubber or wood hammers in forming copper, aluminum and light metals in the automotive and aircraft industries. They have a much longer life, up to 10 times. They are made by placing sheets of 1 to 12 mm. thickness in a steam bath at 100° C. for 1 hr. to produce a tacky condition and then laminating them in a press for 24 hours. The hammer head is machined from the resulting block. Flexible couplings are made in the same manner.

Glider tow rope—An experimental rope was made by stacking 8 bands of Drawerit 20 mm. wide and 3 mm. thick, and placing polyvinyl chloride tubing around them for protection against water. The rope was 30 meters long. A metal ring was cemented into each end of the rope by alternately wrapping the layers of Drawerit around it and cementing it to the underlying layer with polyvinyl alcohol-hydrochloric acid cement. No report had been obtained on its performance.

Gloves—These are made by dipping forms into a hot 15 percent solution of polyvinyl alcohol. Three dips are ordinarily used.

Hoses—Plants in the Berlin area made polyvinyl alcohol hoses for handling gasoline. Gasoline-proof gaskets were made of the same material.

Emulsifying agents—Most polyvinyl alcohol produced is used for making emulsions of polyvinyl acetate. Two percent of Polyviol is commonly employed for this purpose. For an emulsifying agent in preparation of polyvinyl chloride, 0.25 percent of Polyviol is used.

Adhesives—Two tons per month of Polyviol were used in manufacture of adhesives. One was made by Klebstoffwerke at Frankfurt-Mainkur under the trade name Collodin.

Recent research[1]

Information regarding latest developments in laboratory investigations of polyvinyl alcohols was obtained from Dr. Willy Hermann and Dr. Wolfram Haehnel, in charge of research for the Wacker firm and holders of the original patents for polyvinyl alcohol.

A solution of polyvinyl acetate in strong hydrochloric acid, upon standing for 4 weeks, undergoes acid saponification, which hydrolyzes some of the acetyl groups on each individual polymer chain to hydroxyls. This is a new chemical type of material, and differs sharply from the polyvinyl alcohol-acetate made by saponifying polyvinyl acetate with alkali. In this latter case, saponification strips successive chains of their acetylation, giving a mixture of molecules which can be separated by extraction. In the case of the acid-saponified material, no such extraction is possible. These acid solutions have been used as baking varnishes, heating at 120° C. The films are temperature-resistant but are still thermoplastic and have been used in a small way for radiator finishes. They have not yet studied the whole range of products which could be made using this acid saponification. However, they have found, thus far, that the polyvinyl alcohol-acetate made by acid treatment, containing 30 alcohol–70 acetate, is water soluble while the acid product containing 40 alcohol–60 acetate is less water soluble. These materials are more water-resisting in films than materials of the same analysis made by alkaline saponification.

Dr. Hermann generalized on polyvinyl alcohol as an essentially water-insoluble material when old enough, i.e. some years. It can be insolubilized, therefore, by any treatment which hastens this aging, consisting essentially of throwing off bound water to allow secondary valence forces between the chains to bind them together, just as in cellulose. Dewatering by drying, treatment with acids as in Drawerit manufacture, and with chromates and dichromates (sodium or ammonium dichromate in the light or chromic acid in the dark) have this action. The insolubilized polyvinyl alcohol can be treated with sulfur dichloride to vulcanize it. Heating with sulfur has the same action.

In the aged form, it also has the properties of an alcohol and can be reacted to give acetals, the formal forming most readily, acetals and butyrals also being known. The material is also tannable like leather—treatment with ferric chloride followed by tannins giving a leathery, water-insoluble product. He considers heat, age, light and acids as equivalent in producing a fully dehydrated and water-insoluble polyvinyl alcohol.

As an extra bit of evidence that polyvinyl alcohol is essentially water insoluble, he cited efforts to use water solutions as blood-transfusion liquids, 2 to 3 percent solutions having the same osmotic pressure as blood. Fresh solutions worked, but after some weeks the polyvinyl alcohol settled out and the idea could not be applied to field use.

Congo red and benzopurpurin also insolubilize polyvinyl alcohol—even without light—the amount of dye added controlling solubility of the resin. Such colored masses have been used to fill the cavities resulting from the collapse of lungs in the treatment of tuberculosis. They are an improvement over the wax masses formerly used, which would not feel right and would slip after some years and rupture the abdominal lining. Polyvinyl alcohol masses are watery like body tissue. The mass is not only held by connective tissue but will fiber and allow growth of blood vessels through it.

[1] "The German Plastics Industry," by J. M. DeBell, W. C. Goggin and W. E. Gloor, Quartermaster Corps. Office of Publication Board Report 562.

Plastics Digest

This digest includes each month the more important articles of interest to those who make or use plastics. Mail request for periodicals directly to publishers.

General

SUGAR AND SUGAR BY-PRODUCTS IN THE PLASTICS INDUSTRY. L. Long. Scientific Report Series No. 1, Sugar Research Foundation, 61 pp. (Apr. 1945). The interest of manufacturers in the use of sugar or its by-products as raw materials for plastic substances was in evidence as early as 1929, and many attempts have since been made to utilize this abundant natural product. The advantages of sucrose as a plastic raw material are due to its almost unlimited supply as an inexpensive, very pure organic compound. Chemically it has a number of reactive centers, enabling it to polymerize readily or react with other substances to form compounds which can be polymerized. To date, however, results have been of only theoretical interest because of the sensitivity of the molecule to heat and chemical treatment, causing it to discolor readily, and because of the difficulty of controlling the polymerization to produce desirable physical properties in the finished product. On the other hand, a certain degree of success has recently been attained in the formation of a plastic molding compound from bagasse, a waste product from sugar factories, and commercial production has begun on a small scale in Louisiana. Sucrose, and its hydrolysis products glucose and fructose, are potential raw materials for the formation of both colored and colorless plastics of either the phenolic or the alkyd type, the two resins produced in the largest quantity in this country. Sorbitol and mannitol, reduction products of glucose and fructose, should find application as polyhydric alcohols for alkyd resins. Bagasse molding powders are useful in the thermosetting phenolic plastic field. In view of the potential importance to the sugar industry, a survey of the patent and periodical literature was made covering the applications of sugar and sugar by-products in the plastics industry to date.

PLASTIC OVERLAYS FOR DOUGLAS FIR PLYWOOD. J. D. Long. Paper Trade J. *120*, 44–6 (Mar. 22, 1945). A new combination material, consisting of resin impregnated pulp, paper and fabric hot-pressed to the surface of wood veneer and plywood, has been put into production. Currently only two types of these "overlay" materials are in production, but laboratory experiments indicate the postwar production of a wide range of materials for various optical, physical and chemical characteristics. The overlay materials consist of carrier sheets which have been impregnated with thermosetting resins which are polymerized to a stable, easily handled form in the sheet. These are placed on the two faces of the veneer plywood, covered with suitable sheet metal cauls and placed in flat-platen hot presses. Under proper hot-press assembly, selected for the resin and assembly in question, the plastic overlay fuses to the wood base. The carrier sheets exhibiting the most attractive possibilities are pulp and pulp screening sheets of 15 to 50 points thickness and paper sheets of 5 to 10 points. The former usually carry resin impregnations of 15 to 35 percent, and the latter 35 to 70 percent. Phenol-formaldehyde, dimethylolurea and melamine resins are currently of greatest interest. The finished panels present smooth, durable faces with colors or patterns as desired. The natural wood grain may show through the face or be entirely masked. It is possible to impress a texture or die into the face. The lower resin content overlays particularly serve as excellent bases for paint and enamel finishes.

CONTRIBUTIONS OF THE CHEMIST TO INSULATION RESEARCH. JANUARY 1944–JANUARY 1945. The Committee on Chemistry, Conference on Electrical Insulation, National Research Council. 101 pp. This publication contains the following review articles: Frequency Dependence of the Dielectric Behavior of Matter, by O. M. Arnold; 546 references. Rubber Electrical Insulation, by H. C. Crafton, Jr.; 130 references. Insulating Paper, by W. L. Hawkins; 16 references. Synthetic-Plastic Electrical Insulation, by R. F. Boyer and P. C. Woodland; 139 references. Insulating Oil, by C. E. Trautman; 22 references. Ceramic Electrical Insulation, by H. Thurnauer, J. W. Deaderick and A. E. Badger; 27 references.

LEO HENDRIK BAEKELAND. H. V. Potter. Chemistry and Industry *31* and *32*, 242–6, 251–3 (Aug. 4, 11 and 18, 1945). This is a short biography of Backeland with several interesting anecdotes.

PEANUT PROTEIN GLUES. R. S. Burnett, E. D. Parker and E. J. Roberts. Ind. Eng. Chem. *37*, 980–2 (Oct. 1945). Glues have been prepared from peanut protein, isolated from both solvent-extracted and hydraulic-pressed peanut meals, which are suitable for making gummed tape and paper and for making flexible glues of the type used by the setup paper-box maker and the bookbinder. The characteristics of these peanut protein glues, particularly rewettability, tackiness and flow properties, render them suitable for certain gluing purposes for which vegetable proteins have previously been considered unsuitable.

NEW DOW CORNING PLANT PRODUCES SILICONES AT MIDLAND. W. R. Collings. Chem. & Eng. News *23*, 1616–19 (Sept. 25, 1945). The properties of various silicone resins are described. These include aircraft ignition cable insulation, electrical insulation for various types of electrical equipment, laminating resin, damping fluids, antifoaming agents for oils, rubberlike materials and protective coatings.

Materials

PULP-REINFORCED PLASTICS ARE TOUGH AND STRONG. S. L. Schwartz, J. C. Pew and H. R. Meyer. Southern Pulp & Paper J. *8*, 19–22 (Aug. 1945). Strong and tough plastics were obtained by incorporating various powdered phenolic resins with high-quality paper pulp in aqueous suspension, forming the mixtures into mats and, after drying and conditioning, molding the mats under heat and pressure to flat test panels. The ultimate tensile strength of such plastics varied from 20,000 to 25,000 p.s.i., and the Forest Products Laboratory flatwise toughness from 13 to 24 in.-lb. per in. of width. The best of these materials approached in properties those of commercial aircraft-grade, cross-laminated paper plastic. In so far as properties of the plastic are concerned, little variation occurred between the several grades of phenolic resin. The replacement up to 75 percent of the phenolic resin with soda spent-liquor lignin reduced the ultimate strength and raised the water absorption, but the product appeared promising for uses not requiring the better properties obtained with unextended phenolic resin. The pulp plastics formed with 1) lignin, 2) a wood-rosin by-product, 3) lignin in combination with the wood-rosin by-product, 4) lignin in combination with wood-rosin by-product and phenolic resin and 5) lignin in combination with phenolic resin were inferior to those formed with only phenolic resin. Increasing the percentage of resin substantially increased the flow of the mats and improved the water resistance of the plastic, but caused a considerable decrease in ultimate tensile strength and toughness. For most purposes the resin content should be between 40 and 50 percent. To obtain a high-strength pulp plastic it is apparently necessary that the individual pulp fibers

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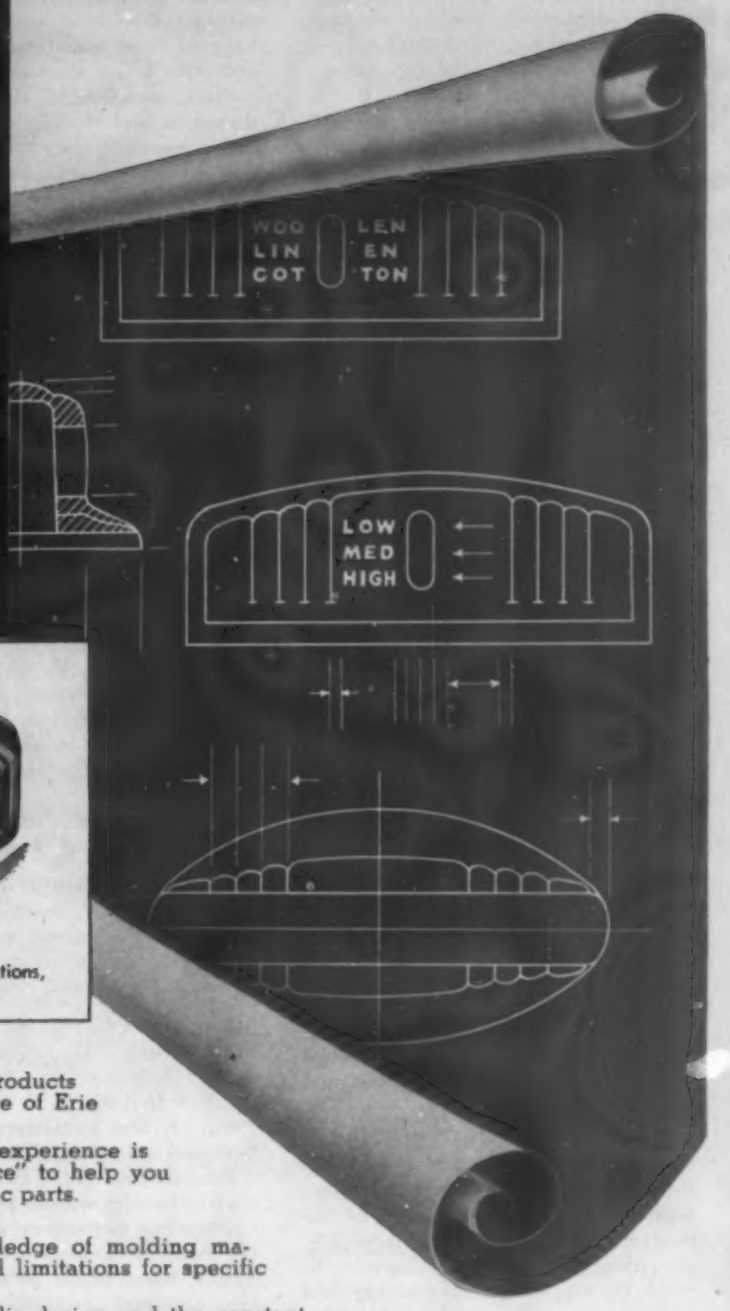

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have high strength and that a good fiber-mat formation exists. The fiber bonding, such as occurs in paper, is believed to have a minor role, for beating the pulp actually decreases the tensile properties of the resulting plastics. Ground-wood pulp plastics lacked toughness but exceeded the toughness of woodflour-filled plastic.

LIQUID RESINS FROM CASHEW NUT SHELL. J. D. Morgan. Paint Manuf. *15*, 73–5 (Mar. 1945). Resins made from cashew nut shell are described. The products are used as paper coatings, gaskets, cistern coatings, resin extenders and plasticizers for chlorinated rubber.

IMPROVED WOOD. II. LAMINATED WOOD. D. Narayanamurti and K. Singh. Forest Research Inst., Dehra Dun, Indian Forest Leaflet, Utilization No. *45*, 7 pp. (1943). The properties of wood laminates made by dipping wood veneers in a solution of phenol-formaldehyde resin, drying and bonding under heat and pressure are reported. The compressive properties, shear strength and hardness are improved. The effect of orienting grain of veneers at various angles to reduce anisotropism of wood was studied.

SILICONE SUMMARY. Chemical Industries *57*, 638–40 (Oct. 1945). This is a summary of the preparation, structure, properties and uses of silicone polymers.

PAPERS FOR THE LAMINATING INDUSTRY. G. Alexander. Paper Trade J. *120*, 37–8 (June 7, 1945). The materials used in the manufacture of laminated products are discussed and reason is given for the choice of filler. There is a discussion of the three general manufacturing techniques: pressing of flat sheets or boards, molding of special shapes or forms, and the rolling and molding of tubes and rods.

TECHNOLOGY OF PHENOLIC RESINS. A. Lewin and P. Robitschek. British Plastics *17*, 316–22, 385–91 (Aug., Sept. 1945). The fundamentals of the reaction between phenols and aldehydes, the various methods for preparing phenolic resins, the types of phenols generally used commercially, the properties of the resins, the formulation of molding compositions and the properties of phenolic moldings, laminates and castings are reviewed. Seventeen references.

CELLULOSE COMPOUNDS IN THERMOPLASTIC LAMINATES. C. W. Eurenius, R. H. Hecht, W. Koch and H. C. Malpass. Ind. Eng. Chem. *37*, 959–63 (Oct. 1945). Thermoplastic laminates prepared by bonding fillers such as cloth and paper with cellulose acetate and ethyl cellulose plastics were evaluated in direct comparison to commercial phenolic-bonded laminates. They were found to possess an unusual degree of toughness, and were readily drawn into complex shapes with inexpensive equipment when softened with heat. They have the additional advantages of quick and easy fabrication and an unlimited range of color possibilities. Properties such as low-temperature flexibility, impact strength, modulus of elasticity, water absorption and electrical insulation behavior can be controlled by proper selection of the bonding plastic and the filler material.

Applications

PLASTICS AND SURGERY. G. Blaine. British Plastics *17*, 331–5 (Aug. 1945). The uses of plastic materials in surgery are reviewed. Acrylic plastics are used in dental plates, facio-maxillary moldings, skullcaps, caps in bone joints and splints. Techniques for forming parts from acrylic plastics are described. Vinyl plastics are used for soft tissue reconstructions, drainage tubes, sutures, tendon substitutes, transparent coatings for burned areas and substitute for blood plasma. Cellulose plastics, although tried for many purposes, are not used in surgery. Polyamides are used as sutures. There are no known uses for thermosetting plastics although several interesting possibilities are being investigated. Protein plastics are used in brain surgery and coverings for burned areas. The alginates are used in repairing eye wounds, treatment of pulmonary tuberculosis and absorbable bandages and gauze. Twenty-four references.

CORRUGATED PERSPEX SHEET. British Plastics *17*, 366 (Sept. 1945). A corrugated transparent methyl methacrylate plastic sheet is described. It is recommended for roof, sidewall lighting.

A NEW STRUCTURAL MATERIAL FOR AIRCRAFT. G. B. Rheinfrank, Jr., and W. A. Norman. Automotive and Aviation Ind. *93*, 32–3, 58, 60 (July 1, 1945). A new resin-impregnated glass-cloth and honeycomb glass core sandwich is being used at Wright Field for fabricating trial fuselage sections and wing panels. Construction methods are simplified, and the resulting product shows strength/weight characteristics 50 percent greater than aluminum construction and 80 percent greater than wood. Comparative strength figures show that during a destruction test of a glass-reinforced sandwich fuselage section which weighed 75 lb., the structure took a load of 2540 lb., or 180 percent of its design load, before breakage of a fitting bolt. The same test with an all metal fuselage of similar design weighing 70 lb. caused failure with a 1550 lb. load. A birch fuselage of plywood construction weighing 86 lb. failed under a load of 1580 pounds. Soundproofing, vibration damping, superior surface smoothness and ease of machining and repair are cited as advantages. Fabricating basic structures of impregnated plastics was heretofore impractical until a strong plastic laminate was available. Glass fibers proved to be more satisfactory than cotton, linen, rayon or silk. The advantages of glass fibers are high impact resistance, low moisture absorption, a strength/weight ratio greater than that of other fibers, and continuous filaments whose physical properties are closely controlled. The resin is a new type copolymer not requiring high pressure or high temperature for curing.

TRANSPARENT MOCKUPS AS TRAINING AIDS. R. E. Holmes. Aero Digest *50*, 135, 137 (Sept. 1, 1945). Transparent plastic models of various devices are used as training aids.

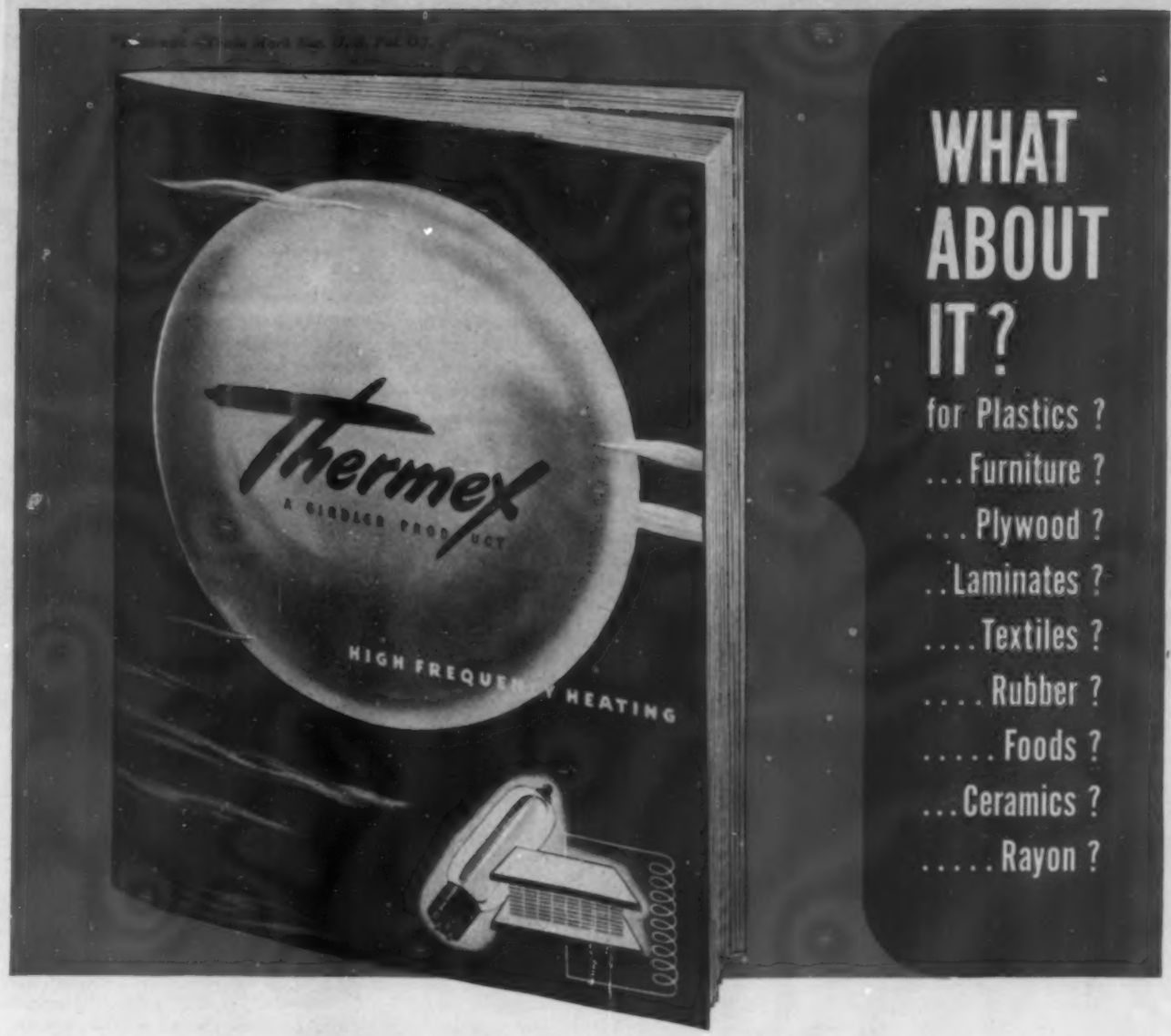
Coatings

HEAT-TREATMENT OF ROSIN. S. R. W. Martin. Paint Manuf. *15*, 8–9, 14 (Jan. 1945). Heat-treatment of rosin to overcome disadvantages is reviewed.

FINISHES THAT GLOW. M. A. Heikkila. Organic Finishing *6*, 9–17 (Sept. 1945). This is a discussion of properties and uses of luminescent pigments in coatings.

FLUORESCENT LACQUERS. J. A. Radley. Paint Manuf. *15*, 115–17, 144 (May 1945). The formulation and applications of fluorescent lacquers have been discussed.

FLAME-SPRAYING PLASTICS. L. J. Doniger. Organic Finishing *6*, 21–3, 31 (Sept. 1945). The spraying of plastics is possible by means of a gun that is capable of spraying powder. The equipment consists of the pistol, powder container, distributor and gas bottles. An instantaneous flow of powder from the container is obtained by pressure of the thumb on an air intake hole on the pistol. The flame temperature is regulated to suit the melting point of the material by adjustment of two micrometer-screw valves. Powder falling from the upper to the lower half of the containers is suspended in air and sucked along the pipeline to the gun at reduced pressure by a partial vacuum created in the gun. High pressure would create stoppages and resulting inefficiency by compaction of the powder in the pipe. With the powder-spraying pistol, compaction is impossible, thus protecting the worker and speeding the operation of the gun. A valve controls the rate of flow of the powder. The pistol is operated by compressed air which draws a stream of powder into the gun. The suspended particles are impelled to the zone of the melting flame and discharged with a high velocity. The gases for the melting flame enter at the bottom of the pistol grip and emerge through concentric annular outlets at the nozzle where they create a fusing zone. The powdered materials pass through this zone and the rate at which the powder flows is susceptible of close control. Polyethylene, Thiokol and polystyrene were successfully applied by this technique.



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Technical Briefs

Abstracts of articles on plastics in the world's scientific and engineering literature relating to properties and testing methods, or indicating significant trends and developments.

Engineering

SOME RHEOLOGICAL PROBLEMS IN THE MANUFACTURE OF BUILDING MASTIC. D. C. Broome. J. Soc. Chem. Ind. *64*, 178–82 (June 1945). The properties of various binders as used in the manufacture of building mastic are considered from a rheological point of view with particular reference to the viscosity at the manufacturing temperatures. The resistance to indentation of the complete building mastic is then considered in relation to binder content and a discussion is included concerning the relation between the results of indentation test of short and long duration with reference to short-period laboratory routine tests and practical indentation under standing loads. The optimum hardness is considered in relation to various practical conditions and the paper concludes with a discussion of the hardening of building mastics by the addition of grit and other similar aggregates, by the incorporation of fine absorbent fillers, and hardening during manufacture and remelting.

METAL BONDING. THE REDUX PROCESS AND SOME OF ITS APPLICATIONS. Automobile Eng. *35*, 354–6 (Sept. 1945). The Redux process, developed by Aero Research, Ltd., for aircraft use, is shown to have several, applications of use to the automobile industry. The process can be used for bonding metal to metal, metal to wood, or metal to a thermosetting plastic. The strength of the joint can surpass the strength of a spot-welded or riveted joint. In addition, the joint is immediately ready for painting or other finishing process. Joints so made are also water resistant and are unaffected by immersion in gasoline or oil. Application has been made to securing clutch and brake linings, wherein the pure shear loads are favorable to Redux joints. The process is particularly valuable for use with light alloys which cannot be soldered or brazed, or which could not be welded after anodizing. Redux joints should be designed as far as possible to be subject only to shear forces. Other factors, such as change in dimensions, are not simply related. Tests show that when Redux joints or any other glued joints are to be adopted for application it is advisable to carry out tests on representative joints and generalize to other dimensions by use of the relation between apparent failing stress and a joint stress factor defined as the square root of the joint thickness divided by the length of overlap. This joint stress factor has two important properties: 1) below the proof stress all joints with the same joint factor fail at approximately the same apparent failing stress, and 2) for small values of the joint factor the apparent failing stress is proportional to the factor. Processing procedure for bonding various surfaces is described.

BONDING OF THERMOSETTING PLASTICS. British Plastics *17*, 367–9 (Sept. 1945). A new process for bonding thermosetting plastics is described. The surfaces to be bonded are abraded in the presence of an activating solution. The prepared surfaces are then ready to be bonded by the usual technique. The surface retains its activation for weeks.

SYNTHETIC INSULATION AND THE 10° RULE. G. L. Moses. Westinghouse Eng. *5*, 106–7 (1945). A review of recent studies of insulation life indicates that the new synthetic insulations follow the basic 10° rule which states that the thermal life of insulation is halved for each 10° increase in temperature or doubled for each 10° decrease.

Chemistry

HYDROXYBENZYL ALCOHOLS FROM PHENOL-FORMALDEHYDE RESINS. I. W. Ruderman. J. Soc. Chem. Ind. *64*, 204 (July 1945). Crystalline deposits were found to have sublimed in the exhaust stacks of tunnel dryers when paper or cloth impregnated with a commercial phenol-formaldehyde ammonia-catalyzed resin was dried. Analysis of these deposits led to the isolation and identification of o- and γ-hydroxybenzyl alcohol. The isolation of these intermediates by sublimation from resins has not been reported before.

ELECTRON-MICROSCOPIC INVESTIGATION OF PRECIPITATES OF CELLULOSE NITRATES. G. Hambraeus and B. Ranby. Nature *155*, 200–1 (1945). Electron-microscopic photographs of precipitated high, medium and low molecular weight cellulose nitrates show micellar, amorphous and fine-grain understructure, respectively. Eight references.

MOLECULAR-SIZE DISTRIBUTION OF CROSS-LINKED POLYSTYRENE. I. Valyi, A. G. Janssen and H. Mark. J. Phys. Chem. *49*, 461–71 (Sept. 1945). The molecular-size distribution of styrene copolymerized with diisopropenyldiphenyl was investigated. It was found that copolymers containing more than 300 p.p.m. diisopropenyldiphenyl are practically insoluble. Samples containing 0, 10, 25 and 100 p.p.m. of the divinyl cross-linking agent were fractionally precipitated from methyl ethyl ketone solution, and the molecular weights of the fractions calculated by application of the equation $[\eta] = KM^a$, where K equals 10^{-4}, a equals 0.72 and $[\eta]$ equals intrinsic viscosity. The molecular weights were found to range from 40,000 to 750,000 for the material containing no cross-linking agent to 1,500,000 for the copolymer with 100 p.p.m. of diisopropenyldiphenyl. Light scattering measurements on a few of the fractions gave molecular weights in reasonable agreement with the viscosity measurements. Molecular weight distributions worked out for the soluble polymers showed that with increasing amount of cross-linking agent the weight average degree of polymerization shifts to smaller values, and the distribution curve flattens out, in accordance with the productions of the Flory and the Stockmayer theories.

A GENERAL THEORY OF THE REACTION LOCI IN EMULSION POLYMERIZATION. W. D. Harkins. J. Chem. Phys. *13*, 381–2 (Sept. 1945). Evidence has been accumulated to show that in emulsion polymerization there are two types of polymerization loci: 1) soap micelles and monomer droplets constituting loci for polymer particle initiation, and 2) monomer in the polymer-monomer (latex) particles, wherein most of the polymer is formed. Monomer diffuses continually from the emulsion droplets into adjacent soap micelles, where it forms monomer (oil) layers which polymerize continually. Monomer droplets also constitute initiation loci even when soap micelles are absent. The latex particles (polymer swelled by monomer) constitute, after their initiation in and escape from the other loci, the locus in which nearly all of the polymer is formed. All hydrocarbon particles (monomer or latex) in an aqueous soap solution are surrounded by an adsorbed monolayer of soap molecules packed with moderate tightness at a soap concentration of 0.1 molar. The polar ends are oriented toward the water and the hydrocarbon ends toward the hydrocarbon particles. Since the polymer-monomer particles are in general very much smaller spheres than the emulsion droplets, the area on which the soap is adsorbed increases rapidly as the material of the monomer droplets is transformed into monomer-polymer (finally polymer) particles. As a result the soap of the micelles is rapidly changed into adsorbed soap, so

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the micelles disappear at a yield (conversion), often rather low, of polymer, which increases with the initial amount of soap present. Above this yield the monomer droplets remain as the only locus for the initiation (or formation) of polymer particle nuclei.

Properties

THE KINETICS OF PACKAGE LIFE. II. THE TEMPERATURE FACTOR. C. R. Oswin. J. Soc. Chem. Ind. *64*, 224–5 (Aug. 1945). The resistance to aqueous penetration of regenerated cellulose wrappings varies approximately as the inverse square of the saturation vapor pressure of water at the temperature of measurement.

ELECTROLYTES IN PLASTICS. D. J. Mead and R. M. Fuoss. J. Am. Chem. Soc. *67*, 1566–70 (Sept. 1945). The electrical properties of the system polyvinyl chloride-diphenylmethane (80:20), containing tetrabutylammonium picrate (10^{-4} to 0.05 *N*), were measured at 45, 55 and 65° C., with d.c. and a.c. over the range 60 cycles to 8 kilocycles. The losses of these dielectrics are greater than the sum of polymer losses plus those due to normal ionic currents. Also the dielectric constant is higher than that of a salt-free dielectric. The increment in loss factor equals that in dielectric constant at a given concentration, frequency and temperature; both increase approximately proportional to salt concentration and decrease inversely proportional to the square root of frequency. Both surface and volume effects are involved.

MEASURING HARDNESS OF PVC. Plastics (London) *9*, 374–5 (Aug. 1945). This article is taken from an article by Saechtling in Kunststoffe *34*, 179 (1944). The Shore and DIN hardnesses are correlated for polyvinyl chloride compounds. Curves are given showing the relation between the Shore hardness and the polyvinyl chloride content of the composition.

EFFECT OF HUMIDITY ON PLASTIC INSULATION. R. F. Field. General Radio Experimenter *20*, 6–12 (July and Aug. 1945); Plastics and Resins 4, 5–10, 34, 36 (Sept. 1945). Measurements of surface and volume resistivities of plastics insulation at various relative humidities are discussed from the point of view of rate of change and of equilibrium values. The results are shown for 40 materials. The high resistivity of cellulose acetate butyrate shows that volume water absorption cannot be taken as the guide to electrical resistivity.

THERMAL EXPANSION AND SECOND-ORDER TRANSITION EFFECTS IN HIGH POLYMERS. R. F. Boyer and R. S. Spencer. J. Applied Phys. *16*, 594–607 (Oct. 1945). The nature of the thermal expansion anomaly in high polymers, known as the second order transition, is examined in some detail. It is suggested that below the transition temperature polymer chains can expand sidewards but not parallel to their length. At the transition temperature lengthwise expansion becomes prominent, thus accounting for the sudden increase in thermal expansion. Experimental results are presented showing the anisotropic expansion of oriented polymers below the transition temperature. The transition effect is then treated as a problem in viscous flow, which gives rise to various semi-empirical plots connecting the transition temperature with applied forces, plasticizer content, and time effects. The brittle point involves highly elastic deformation, and is shown to be a fundamentally different test, although the transition temperature and the brittle point are sometimes numerically equal. Various factors influencing the brittle point are reviewed briefly.

Testing

TEMPERATURE-CONTROL DEVICE FOR MACMICHAEL VISCOMETER. W. A. Rice. Ind. Eng. Chem., Anal. Ed. *17*, 676 (Oct. 1945). A device for controlling the temperature of the sample being tested on a MacMichael viscometer is described.

MICROSCOPIC EXAMINATION OF PLASTIC MATERIALS. J. H. Wredden. Plastics (London) *9*, 341–6, 369–73, 437–42, 485–92 (July, Aug., Sept. and Oct. 1945). Microscopic techniques for determining the structure and quality of laminated materials are described. Thirty-three microphotographs are used for illustration. The author shows how microscopic techniques can be used as a suitable adjunct to physical and chemical testing. Various phenomena observed in making strength and water absorption tests may be clarified by these techniques.

METHODS OF TESTING FINISHED MOLDINGS. B. Shearman, B. C. Fleming-Williams, Z. Rogowsky and D. J. Strong. Report of the British Electrical and Allied Industries Research Association. Investigations to ascertain whether tests usually carried out on molded materials with standard test-pieces could be made on miniature specimens cut from finished moldings are described. Methods of cutting the moldings are discussed and specimen sizes are suggested. Tests which could be applied to specimens obtained from moldings were evolved for impact strength, cross-breaking strength, crushing strength, electric strength, surface resistivity, plastic yield with temperature, resistance to heat, specific gravity and water absorption. The results obtained by these tests are compared with those of standard tests to see how far correlation is obtained.

A NEW CUTTING-WIRE PLASTOMETER. L. L. Lyon and R. D. Vold. Ind. Eng. Chem., Anal. Ed. *17*, 585–90 (Sept. 1945). The article describes the construction and operation of a new cutting-wire plastometer, suitable for use with substances of high viscosity which must be maintained at constant relative humidity as well as at constant temperature. Yield values, rate of flow at different velocities, and extent of elastic recovery can be studied with this instrument, thus permitting construction of curves which depict the complete rheological behavior of the materials that are being studied.

Synthetic rubber

EXTENDERS FOR GR-S. L. E. Ludwig, D. V. Sarbach, B. S. Garvey, Jr., and A. E. Juve. India Rubber World *112*, 731–7 (Sept. 1945). A wide variety of materials which might serve as useful extenders for GR-S was investigated and a picture of their physical properties and behavior is presented so as to facilitate practical application by the compounder. A number of valuable materials were found which met the requirements of a satisfactory extender as formulated herein. Eight rather well-defined groups of extenders were established together with the principal physical properties characteristic of each group. This classification should serve as a useful guide to the compounder when working with GR-S, both as an aid toward the design of successful compounds and as a logical basis with which to predict the properties of new materials as they become available.

SYNTHETIC RUBBER MECHANICAL PARTS IN PRESENT AND POST-WAR VEHICLES. E. F. Riesing. SAE J. *53*, 542–59 (Sept. 1945). The properties of synthetic rubbers and their applications in mechanical parts are discussed. The applications are related to the principal properties involved. The topics discussed include 1) tension modulus at operating temperature, 2) resilience, 3) efficiency, 4) low-temperature flexing properties, 5) resistance to ultraviolet rays, ozone, acid and gas diffusion, 6) electrical resistivity, 7) resistance to oils and coolants, 8) physical properrties at low frequencies, 9) hysteretic and elastic properties, 10) creep and stress relaxation under load, 11) change in modulus with time, and 12) the future. In the appendix, the various types of synthetic rubber are described briefly and the principal technical terms used are defined.

THE WEAR OF THIOKOL AND OF THIOKOL-LEATHER-RESINOID SOLING MATERIALS. A. Colin-Russ. India-Rubber J. *108*, 76–9 (1945). Soles and heels made of Thiokol and leather resinoid are superior to standard rubber mixtures in resistance to abrasion. They also have excellent resistance to oils and solvents which makes them of advantage for use in garages and factories. Data concerning serviceability are presented.

These phenolic safety razor handles, complete with threaded metal insert, represent typical compression molded parts. Made by Michigan Molded Plastics, incorporated in a 200-ton H-P-M press equipped with 50 cavity mold, production averages 400 handles per hour. Actual curing time is 1-1/2 minutes. Inserts are manually positioned in die cavities.

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SILICON POLYMERS. E. G. Rochow (to General Electric Co.). U. S. 2,383,817, Aug. 28. A polymeric organosilicon compound.

SILICON RESINS. M. M. Sprung (to General Electric Co.). U. S. 2,383,827, Aug. 28. A silicon resin is prepared by heating a solution of an organosilicon resin in an inert aromatic hydrocarbon in contact with a hydrated metal salt.

POLYMER. N. S. Beekley, Jr. (to Jasco, Inc.). U. S. 2,383,839, Aug. 28. A resin comprising a low-temperature olefin-diolefin interpolymer.

SHEET MATERIAL. C. J. Davies (to National Automotive Fibres, Inc.). U. S. 2,383,849, Aug. 28. Sheet material comprising loosely aggregated fibrous material which has been bonded with a thermoplastic resin.

RESIN. O. Moldenhauer and H. Bock (to Alien Property Custodian) U. S. 2,383,880, Aug. 28. Polycondensates prepared by mixing thiosemicarbazide with sebacic anhydride and fusing at a temperature of 200° C.

RESIN. A. H. Bump (to Monsanto Chemical Co.). U. S. 2,383,933, Sept. 4. An aqueous dispersion of a resin is prepared by reacting an unsaturated ketone or aldehyde with a compound containing a conjugated double bond, by mixing in water in the presence of alkali and heating under superatmospheric pressure at a temperature between 140 and 200° C.

PLASTIC. L. Daly. U. S. 2,384,015, Sept. 4. A thermosetting composition comprising an alpha-phase phenol-furfuraldehyde, calcium stearate, a filler such as lignin, cotton flock or cotton waste, and polychloroprene.

POLYVINYL ACETAL. C. W. Johnson (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,384,034, Sept. 4. A composition comprising a polyvinyl acetal and a softening-point elevating agent.

POLYNITROETHYLENE. A. E. W. Smith, C. W. Scaife and R. H. Stanley (to Imperial Chemical Industries, Ltd.). U. S. 2,384,049, Sept. 4. Polymerized nitroethylene is prepared by reacting beta-nitroethyl nitrate in the presence of water with a metal hydroxide or carbonate.

MODIFIED ROSIN. L. Auer. U. S. 2,384,061-2-3-4, Sept. 4. Rosin is modified by treating with an inorganic oxygen-containing acid of nitrogen or an aromatic amino compound.

MILLING OF RESINS. E. K. Bolton (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,384,070, Sept. 4. A resinous methyl methacrylate polymer of reduced viscosity in solution in toluene containing an organic thiol milled with the resin at 125 to 200° C.

RESIN. H. L. Gerhart (to Pittsburgh Plate Glass Co.). U. S. 2,384,085, Sept. 4. Hard, clear, strong plasticized styrene-maleic anhydride copolymers are prepared by admixing styrene, maleic acid and dimethyl phthalate and subjecting to polymerization conditions.

POLYMERS. I. E. Muskat and F. Strain (to Pittsburgh Plate Glass Co.). U. S. 2,384,115–2,384,225, Sept. 4. Polymers of an ethylene glycol bis(alkenyl) carbonate; a neutral ester of carbonic acid and a monohydroxy ester of a monohydroxy aromatic carboxylic acid and a monohydric alcohol; a neutral ester of an aliphatic monohydroxy carboxylic acid having a single hydroxy group adjacent to an alkyl carbon atom and a monohydric alcohol having an unsaturated group; a neutral ester of an unsaturated monohydric alcohol and lactic acid and a partial ester of carbonic acid and an unsaturated monohydric alcohol; a neutral ester of a dicarboxylic acid and a half ester of a glycol and a monocarboxylic acid having an olefin linkage; a neutral ester of a monohydroxy ester of a monohydroxy aliphatic monocarboxylic acid having the hydroxy group in the beta position and a monohydroxy alcohol having an unsaturated group and a partial ester of carbonic acid and a monohydroxy alcohol; a neutral diester of carbonic acid and a monohydroxy ester of an aliphatic monocarboxylic acid having a single hydroxyl group in the alpha carbon atom and an unsaturated monohydric alcohol; a neutral ester of carbonic acid and a monohydroxy ester of a monohydroxy polycarboxylic acid and a monohydric alcohol having unsaturation in an aliphatic straight chain; an unsaturated monohydric alcohol ester of a polycarboxylic acid, an unsaturated mixed carbonic acid ester; a dipropylene glycol bis(alkenyl) carbonate; and a complex unsaturated carbonic acid mixed ester.

COATING. J. W. Raynolds. U. S. 2,384,132, Sept. 4. A coating comprising chlorinated rubber, polyvinyl acetate and a plasticizer such as chlorinated paraffin or an oil-modified alkyd resin.

RESIN. F. J. Soday (to United Gas Improvement Co.). U. S. 2,384,141, Sept. 4. A resinous polycyclopentadiene containing a secondary aryl amine.

EXTRUSION. E. G. Williams (to Imperial Chemical Industries, Ltd.). U. S. 2,384,224, Sept. 4. A process for preparing wire insulated with a solid polymer of ethylene comprising passing wire and molten polymer through a die and immediately thereafter into a cooling bath.

UREA-FORMALDEHYDE. D. E. Cordier (to Libbey-Owens-Ford Glass Co.). U. S. 2,384,367, Sept. 4. A thermosetting composition comprising a urea-formaldehyde reaction product and a latent curing catalyst comprising a modified amide.

RESIN. G. F. D'Alelio (to General Electric Co.). U. S. 2,384,369, Sept. 4. The reaction product of an aldehyde and a triazole derivative.

RESIN FOAM. L. S. Meyer (to Libbey-Owens-Ford Glass Co.). U. S. 2,384,387, Sept. 4. A hardened urea-formaldehyde resin foam is strengthened by compressing in the presence of heat.

TERPENE RESINS. A. L. Rummelsburg (to Hercules Powder Co.). U. S. 2,384,400, Sept. 4. A resinous copolymerizate of an acylic terpene having three double bonds and a material having two conjugated double bonds.

CELLULOSE NITRATE. E. Berl. U. S. 2,384,415, Sept. 4. Nitrates of cellulose, starch or other alcohols are stabilized by treating with nitric acid and a mixture of phosphoric acid and phosphorous pentoxide or a mixture of glacial acetic acid and acetic anhydride.

PLASTIC MATERIAL. J. C. Cowan and H. M. Teeter (to U. S. Dept. of Agriculture). U. S. 2,384,443, Sept. 11. A plastic composition comprising a mixture of a dihydric alcohol polyester of a polymeric fatty acid and a rubber compounding agent.

EXTRUSION METHOD. B. Andersen and R. F. Strasdin (to Celanese Corp. of America). U. S. 2,384,521, Sept. 11. Articles are molded from thermoplastic materials by converting a cellulose derivative and feeding, while it is molten, into a mold cavity.

POLYVINYL ACETAL. J. M. DeBell and E. R. Derby (to Monsanto Chemical Co.). U. S. 2,384,537, Sept. 11. A polyvinyl acetal resin made with butyraldehyde or formaldehyde and plasticized

Machining master hob on duplicating machine in Tech-Art tool room.

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VINYL POLYMER. H. P. Heller (to Radio Corp. of America). U. S. 2,384,619, Sept. 11. A composition comprising a solid solution of a resinous polymer of a vinyl aromatic compound and a hydrogenated resinous polymer of a vinyl aromatic compound.

RESIN. C. G. Moore (to Glidden Co.). U. S. 2,384,846, Sept. 18. A resinous material is prepared by reacting glycerol and fatty acids of the drying oil type until a neutral product is formed and heating with maleic anhydride at 250° to 300° F.

ETHYLENE POLYMERS. F. T. Peters (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,384,848, Sept. 18. Dispersions of polyethylene are prepared by dissolving in a hydrocarbon or chlorinated hydrocarbon solvent boiling between 80 and 175° C. by heating the mixture above 110° C. and cooling slowly to below 35° C. with rapid agitation.

FABRIC TREATMENT. C. P. Atkinson (to Courtaulds, Ltd.). U. S. 2,384,871, Sept. 18. Raised fabrics are prepared by treating the fibers with an intermediate resin, subjecting the fibers to a raising operation, and finally converting the resin into the insoluble form.

THERMOPLASTICS. T. W. Bartram (to Monsanto Chemical Co.). U. S. 2,384,876, Sept. 18. A composition prepared by mixing a natural rubber, polymers of butadiene, acrylonitrile, styrene, chlorobutadiene, scrap rubber or reclaimed rubber with an organo sulfo phosphine halide, and heating the mixture.

VINYLIDENE CHLORIDE. E. C. Britton and H. W. Moll (to Dow Chemical Co.). U. S. 2,384,880-1-2-3-4-5-6, Sept. 18. Thermoplastic compositions containing vinylidene chloride and a urea-formaldehyde resin, a coumarone-indene resin, a natural resin, a hydrogenated rosin, a toluenesulfonamide aldehyde resin, a polyvinyl acetal resin, an oil-modified phenol-aldehyde resin or a cellulose ether.

CELLULOSE DERIVATIVE. W. J. Burke (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,384,888, Sept. 18. An acetyl-thioalkyl ether of cellulose wherein the alkyl group contains at least two carbon atoms.

VINYLIDENE CHLORIDE. A. W. Hanson and W. C. Goggin (to Dow Chemical Co.). U. S. 2,384,910, Sept. 18. A thermoplastic composition which contains both vinylidene chloride and white shellac.

POLYMERS. R. L. Holmes (to Jasco, Inc.). U. S. 2,384,916, Sept. 18. High polymers are prepared by polymerizing unsaturated hydrocarbons such as isobutylene and a diolefin at a temperature below −10° C. in the presence of a Friedel-Crafts catalyst and also an aliphatic ether.

CONDENSATES. E. Lieber (to Standard Oil Development Co.). U. S. 2,384,935, Sept. 18. Condensates are prepared by reacting an alkyl aryl ketone with a low molecular weight carbonyl-containing interlinking agent such as an aldehyde or a ketone in the presence of a dehydrating catalyst at a temperature of 100° to 300° F. and subjecting to steam distillation at temperatures up to 600° F. to obtain the desired condensate as a distillation residue.

FABRIC. S. C. Lilley and E. E. Foster (to United Elastic Corp.). U. S. 2,384,936, Sept. 18. Woven elastic fabrics are produced by interweaving elastic strands with strands of a heat-shrinkable artificial resin and heating to shrink the resin and cause it to grip the elastic.

VINYLIDENE CHLORIDE. L. A. Matheson (to Dow Chemical Co.). U. S. 2,384,947, Sept. 18. A thermoplastic composition comprising vinylidene chloride polymer and an unmodified phenol-formaldehyde resin.

VINYLIDENE CHLORIDE. F. B. Smith (to Dow Chemical Co.). U. S. 2,384,973, Sept. 18. A thermoplastic composition comprising vinylidene chloride polymer and a compound such as diphenyl ether modified with a group such as cyclohexyl.

NITROETHYLENE POLYMERS. A. E. Smith (to Imperial Chemical Industries, Ltd.). U. S. 2,385,037, Sept. 18. Polymerized nitroethylene is prepared by reacting 1,2-dinitroethane in the presence of an aqueous medium with an alkali or alkaline earth metal salt.

TEXTILE TREATMENT. G. W. Seymour and D. Y. Miller (to Celanese Corp. of America). U. S. 2,385,110, Sept. 18. An aqueous composition for sizing cellulose yarns comprising polymerized ethylene oxide, a wetting agent and polymerized methacrylic acid or its salts, copolymerized methacrylic and acrylic acids, or interpolymers of methacrylic acid and styrene, vinyl acetate or methyl methacrylate.

VINYLIDENE CHLORIDE. E. C. Britton and H. W. Moll (to Dow Chemical Co.). U.S. 2,385,256, Sept. 18. A thermoplastic composition comprising vinylidene chloride and an alkyd resin.

ACRYLONITRILE. A. M. Clifford (to Wingfoot Corp.). U. S. 2,385,258, Sept. 18. Plastic masses comprising polymerized alpha-substituted acrylonitrile.

VINYLIDENE CHLORIDE. R. M. Wiley (to Dow Chemical Co.). U. S. 2,385,318, Sept. 18. Articles are prepared from vinylidene chloride by melting the material, forming into a thin stream, cooling to the temporarily tacky stage, forming a unitary mass by uniting tacky surfaces, shaping at a temperature between 90° C. and 10 degrees below the melting point and maintaining in the same range until the article is hardened.

COLORING. R. D. Greene, R. H. Kienle, and R. D. Vartanian (to American Cyanamid Co.). U. S. 2,385,320, Sept. 18. Textile coloring is effected by treating with an emulsion containing a pigment and a binder comprising a heat-curable alkylated amide-aldehyde resin or alkyd resin.

CELLULOSE ETHERS. M. J. Hunter and E. Kropscott (to Dow Chemical Co.). U. S. 2,385,359, Sept. 25. A highly impact resistant composition comprising ethyl cellulose plasticized with an alkyl ester of hydroxy-acyloxystearic acid.

RESINS. A. J. Norton (to Pennsylvania Coal Products Co.). U. S. 2,385,370, Sept. 25. A resin prepared by forming a mixture of a dihydroxy benzene, a non-alkaline catalyst, and a diluting medium adapted to prevent premature cure, heating under reflux to such a point as to insure instantaneous reaction with subsequently added aldehyde, treating with successive increments of aldehyde, continuing reflux, removing water, cooling and mixing with a potential hardening agent.

ABRASIVE. P. H. Rhodes (to Pennsylvania Coal Products Co.). U. S. 2,385,371, Sept. 25. Abrasive articles are prepared by mixing abrasive particles with a heat-hardenable adherent mixture of a dihydroxy benzene-aldehyde resin and a methylene-containing setting agent, and curing at a temperature of 80 to 125° C.

RESIN. P. H. Rhodes (to Pennsylvania Coal Products Co.). U. S. 2,385,372, Sept. 25. A permanently fusible resin is prepared by reacting resorcinol and formaldehyde in the absence of a catalyst, adding a small amount of catalyst toward the end of reaction before gelation occurs and all of the aldehyde is reacted, heat reacting the remainder of the formaldehyde in the presence of the catalyst, the amount of aldehyde in the reaction being just sufficient to insure a permanently fusible resin.

RESIN. P. H. Rhodes (to Pennsylvania Coal Products Co.). U. S. 2,385,373, Sept. 25. A permanently fusible resin is prepared by forming under reflux in the presence of an acid an undehydrated reaction product of a monohydric phenol with an aldehyde, dissolving a polyhydroxy benzene in an aldehyde, adding to the undehydrated reaction product at an elevated temperature, reacting until all aldehyde is combined and then finally dehydrating. (*Please turn to next page*)

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ADHESIVE. P. H. Rhodes (to Pennsylvania Coal Products Co.). U. S. 2,385,374, Sept. 25. An aqueous bonding liquid containing a heat reactive mixture of hexamethylenetetramine and an aqueous solution of a resinous reaction product of a mixture of an aldehyde and a dihydroxy benzene, said solution having a pH between 7 and 9, thereby permitting dilution to a resin-solids content lower than 30 percent while remaining stable.

PLASTICIZER. C. Opp (to Interchemical Corp.). U. S. 2,385,377, Sept. 25. A plasticizer for cellulose esters comprising the resinous reaction product of sebacic acid, succinic anhydride, ethylene glycol, glycerol and castor oil.

MELAMINE - FORMALDEHYDE. P. C. Schroy (to American Cyanamid Co.). U. S. 2,385,383, Sept. 25. Melamine and formaldehyde are reacted at a pH of 6.2 to 6.4 at a temperature of 50 to 90° C. for one half hour, the pH is adjusted to 7, water is removed with heat and vacuum, resin is cooled, powdered.

MOLDING COMPOSITION. P. C. Schroy (to American Cyanamid Co.). U. S. 2,385,384, Sept. 25. A composition comprising a thermosetting condensate, which may be cured in the presence of alkali, and asbestos fiber which has been heat treated.

BUTTON. F. G. Purinton (to Patent Button Co.). U. S. 2,385,467, Sept. 25. A plastic button having metallic insignia on the face.

THERMOPLASTIC SHEET. W. Bartoe and W. R. Speek (to Röhm and Haas Co.). U. S. 2,385,486, Sept. 25. Thick centered sheets of organic thermoplastic polymer are prepared by forming a cell of two parallel, flat, sheets of material held in spaced relationship and sealed along their perimeter, said sheets being capable of bulging under the weight of the contents of the cell, filling with a polymerizable material and polymerizing.

RUBBER HYDROCHLORIDE. H. J. Osterhof and L. E. Cheney (to Wingfoot Corp.). U. S. 2,385,532-3-4-5, Sept. 25. Containers for lubricating oil consisting of rubber hydrochloride plasticized with dimethoxyethyl phthalate, diethoxyethyl succinate, di-2-chloroethyl sebacate, dicyclohexyl sebacate, dimethoxyethyl or diethoxyethyl adipate, or di-2-chloroethyl hexahydrophthalate.

STENCIL. A. Baczewski. U. S. 2,385,562, Sept. 25. A printing stencil prepared from a textile fabric coated with a film of vinyl halide-acetate copolymer.

UMBRELLA FRAME. S. Isler. U. S. 2,385,575, Sept. 25. A composite rib construction for umbrella frames comprising plastic rib sections.

CONDENSATES. H. Rudy and R. Watsel (to Alien Property Custodian). U. S. 2,385,586, Sept. 25. Condensates are prepared from sulfite waste liquor by reacting with a phenol and anhydrous phosphoric acid until a homogeneous mass is obtained.

OLEFINS. A. Clark and R. S. Shutt (to Battelle Memorial Institute). U. S. 2,385,609, Sept. 25. Normally gaseous ethylene, propylene and butylene are polymerized by passing through a reactor in contact with a catalyst such as a chromite of zinc, copper, or cadmium at 200 to 600° C. under pressures of from 200 to 1500 p.s.i.

DIOXANE POLYMERS. G. T. Vaala and R. B. Carlin (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,386,661, Sept. 25. Polymers are prepared by cleaving with a strong acid such as hydrochloric or a chloride of a saturated fatty acid a six-membered heterocyclic ring such as 4-methyl-1,3-dioxane or 1,3-dioxane and then polymerizing with a Friedel-Crafts catalyst.

MOLDED ARTICLE. S. J. Bers (to Armstrong Cork Co.). U. S. 2,385,679, Sept. 25. Plastic articles are prepared from zein, pine wood resin and paraformaldehyde as well.

COPOLYMERS. R. R. Dreisbach (to Dow Chemical Co.). U. S. 2,385,695, Sept. 25. A rubberlike copolymer consisting of a lower aliphatic conjugated diolefin, an alkyl alpha-methylene-alkyl ketone, an alpha-methylene-alkyl cyanide.

SIZING COMPOUNDS. F. G. La Piana and H. S. Bosland (to Stein, Hall and Co., Inc.). U. S. 2,385,714, Sept. 25. A textile sizing material comprising an amylaceous material, a water-soluble urea-aldehyde condensate and polyvinyl alcohol.

MOLDING COMPOUND. V. A. Navikas (to Armstrong Cork Co.). U. S. 2,385,721-2, Sept. 25. Molded articles are made from zein and pine wood resin.

TEXTILE FINISHING. J. T. Thurston (to American Cyanamid Co.). U. S. 2,385,765, Sept. 25. Textile finishes comprising the aldehyde condensates of guanamine or N-substituted guanamines.

ABRASIVES. R. S. Daniels and A. J. Mostello (to Bakelite Corp.). U. S. 2,385,776, Oct. 2. Abrasive articles comprising abrasive grains and a bonding agent comprising the reaction product of a diolefine adduct of a conjugated unsaturated dibasic acid and a polyhydric alcohol or a polyalkylol amine.

PROTEIN PLASTICS. J. D. Ferry and E. J. Cohn (to Research Corp.). U. S. 2,385,802-3, Oct. 2. Plastics are prepared from blood by removing the corpuscles, precipitating fibrinogen, drying the latter and mixing with a plasticizer with or without the addition of another protein and setting with heat.

CONDENSATES. A. G. Chenicek (to Pittsburgh Plate Glass Co.). U. S. 2,385,911, Oct. 2. Condensation products of aldehydes and unsaturated ester amides.

CELLULAR PLASTICS. J. W. Jordan (to Pittsburgh Corning Corp.). U. S. 2,385,921, Oct. 2. An adherent cellular layer of plastic material is formed on glass by coating the surface of the glass with hydrolyzed ethyl silicate and spraying with a solution of a vinyl acetal resin in ethyl alcohol at 165° F. so as to trap bubbles in the vinyl acetal layer.

POLYESTER RESINS. I. E. Muskat and F. Strain (to Pittsburgh Plate Glass Co.). U. S. 2,385,930, Oct. 2. An ester of a tetraethylene glycol and a half ester of carbonic acid and an alcohol such as allyl, methallyl or crotyl.

UNSATURATED POLYESTERS. I. E. Muskat and F. Strain (to Pittsburgh Plate Glass Co.). U. S. 2,385,931-2-3-4, Oct. 2. Polyesters of unsaturated, aliphatic monohydric alcohols, aromatic acids, aliphatic acids, polyhydric alcohols and unsaturated acids.

TERPENE RESINS. A. L. Rummelsburg (to Hercules Powder Co.). U. S. 2,386,063, Oct. 2. A polymer comprising the polymerization product of a saturated bicyclic terpene catalyzed at a temperature between 0 and 300° C.

ADHESIVE. H. H. Harkins (to United States Rubber Co.). U. S. 2,386,112, Oct. 2. Rubber is bonded to solid non-rubber surfaces by applying to the latter a base coat of a soluble phenol-aldehyde resin and an oxidizing agent such as tetrachloroquinone, para benzoquinone, benzoyl peroxide, polynitroaryl compounds, quinone-imines, lead peroxide, manganese dioxide, mercuric oxide, or lead chromate, applying thereover a vulcanizable rubber stock and heating the assembly.

PLASTIC. P. B. Roberts (to P. B. Roberts and A. Squyres). U. S. 2,386,264, Oct. 9. A plastic material prepared by adding dry protein to cactus juice until coagulated.

INTERPOLYMERS. J. R. Roland, Jr. (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,386,347, Oct. 9. A solid, macromolecular, hydrolyzed interpolymer of ethylene and a vinyl ester of an organic monocarboxylic acid.

PLASTICIZER. R. T. K. Cornwell (to Sylvania Industrial Corp.). U. S. 2,386,381, Oct. 9. A plasticizing composition comprising the dialysis product of the residue obtained by distilling the fermentation product of a fermentable sugar.

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Our method of low pressure lamination accommodates "tricky" shapes as easily as simple ones. As to size, the 14' PlastiCraft is but one example. Beyond that, our modern plastics and tough fibrous materials cured under heat and pressure, combine to offer light weight products that possess great tensile and impact strength. Resilient and dielectric, they are also highly resistant to vibration, elements and corrosion.

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Books and Booklets

Write directly to the publishers for these booklets. Unless otherwise specified, they will be mailed without charge to executives who request them on business stationery.

Plastics: What everyone should know

by Bernard Wolfe

Published by Bobbs-Merrill Co., Inc., 486 Fourth Ave., New York, N. Y.

Price $2.50 **189 pages**

Fulfilling the promise in its title, this book presents some basic information about plastic materials, their history, their range of use and outstanding properties in an entertaining, easy-to-take style that should satisfy the layman's curiosity about plastics.

The language is simple and non-technical, the treatment is light, and while a book of this type can obviously only skim the surface, there is sufficient factual information and intelligent analysis of the subject to provide a well-rounded, carefully outlined picture of the plastics field.

The author has even attempted to *define* plastics, pointing out the difference between a synthetic chemically polymerized substance and other inorganic moldable materials like concrete.

The chapter on the future of plastics is excellent in that it is enthusiastic without being exaggerated or overly imaginative. This book is indeed a refreshing popular approach to plastics and a valuable supplement to the industry's own program of general education.

H. B. J.

British Plastics Year Book, 1945

Published by Iliffe & Sons, Ltd., Dorset House, Stamford St., London, S. E. 1, England, 1945

Price, 20/-net **494 pages**

Divided into nine sections, the yearbook contains a review of recent patents; materials used in the plastics industry; manufactured products; plant and equipment used in the plastics industry; proprietary names, trade marks, general nomenclature; names and addresses of companies, societies, consultants, research specialists; Who's Who in the plastics industry; associations, federations; technical data, engineering and chemical tables.

Catalytic Chemistry

by Henry W. Lohse

Published by Chemical Publishing Co., Inc., 26 Court St., Brooklyn 2, N. Y., 1945

Price $8.50 **416 pages**

Of general interest to the chemist, chemical engineer and technical worker of all industries, this new book has as its aim the factual presentation of the underlying principles of catalytic phenomena and the application of catalytic reactions in industrial processes. Special attention has been paid to the presence of impurities in catalytic reaction systems and to the role of traces of other metals in silver, copper, iron, nickel, etc., used as catalysts.

Each of the various types of catalytic reactions is taken up in a section which discusses in detail the nature and properties of catalysts, specific types of catalytic reactions, as well as industrial catalytic reactions. Numerous illustrations serve to clarify the phenomena described.

★ The first issue of *Plastics Newsfront*, an external house magazine dealing with applications of molding compounds, resin adhesives and laminating resins, has been released by the Plastics Division, American Cyanamid Co., New York 20, N. Y. Profusely illustrated in four colors, the publication is a media for nontechnical information on new plastic developments.

★ Fiberglas as an engineering material is the subject of a 42-page mimeographed paper prepared by the Bureau of Industrial Service, Inc., New York 17, N. Y., for Owens-Corning Fiberglas Corp., Toledo 1, Ohio. The pamphlet traces the development and manufacture of the material, discusses properties, war and postwar uses and research on Fiberglas.

★ The 3-M Wetordry method of precision grinding and finishing at high speeds is described in a 12-page booklet entitled "Faster, Better Finishing of Metal, Plastic and Glass." Released by Minnesota Mining & Mfg. Co., St. Paul 6, Minn., the leaflet uses non-technical language to explain how this modern grinding and finishing method keeps operating heat at a minimum; eliminates distortion, discoloration and plastic flow; increases the life of abrasive belts; and eliminates the hazard created by dust when grinding glass, ceramics and certain metals.

★ Hydraulic Press Mfg. Co., Mt Gilead, Ohio, has published an 84-page booklet (bulletin 4500) which tells the story of modern hydraulics, tracing the development of hydraulic presses up to the present time and describing the operations of forming and drawing, forging and die casting. One section is devoted to shop presses and another to plastic molding presses of the compression, electronic and injection types and to laminating presses. Presses for special processes are shown.

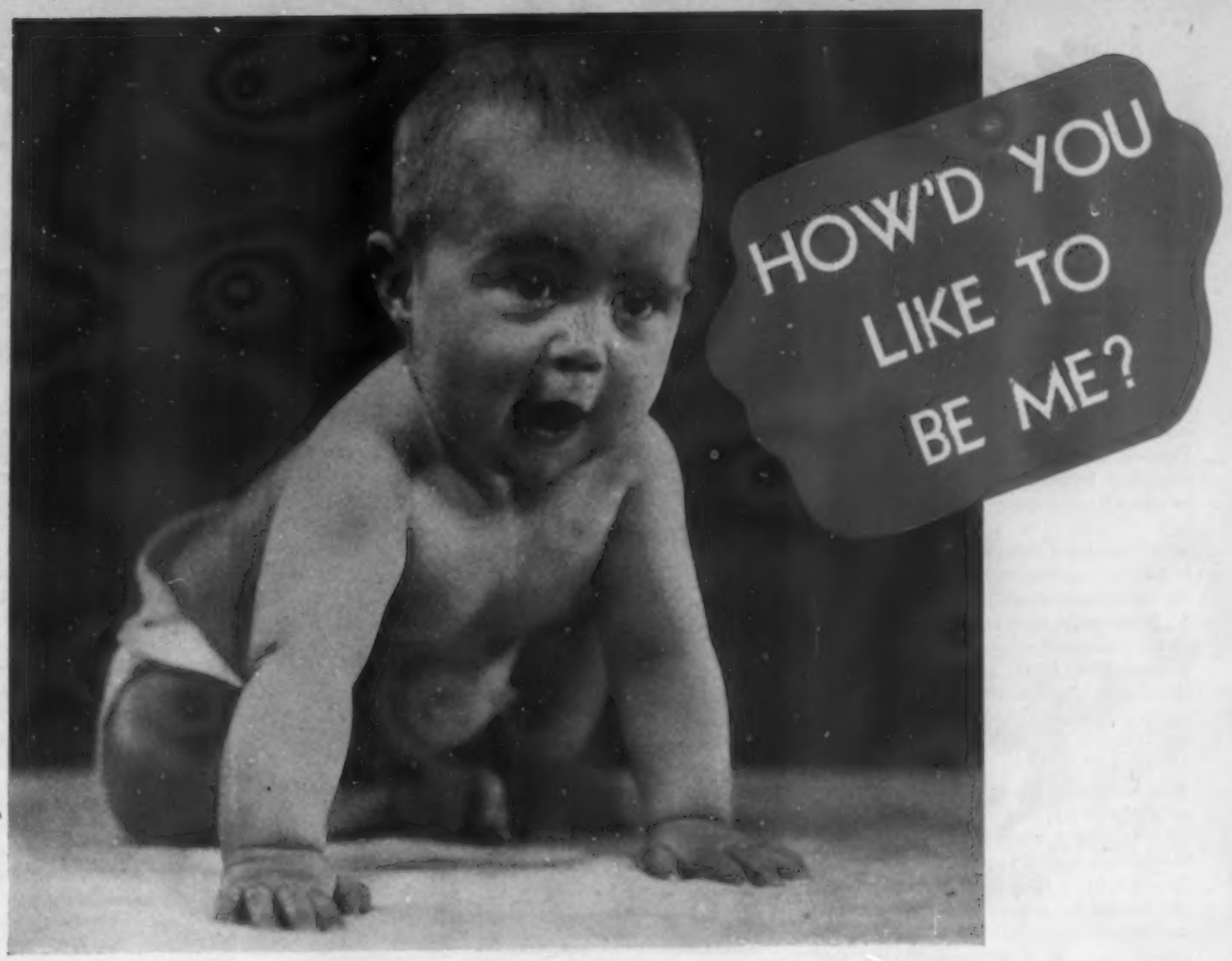
★ "Resin Baking Coatings by Induction Heating," a speech presented at the 1945 Fall Regional Meetings of the Federation of Paint and Varnish Production Clubs by Robert J. Moore, Bakelite Corp., New York 17, N. Y., has been arranged in booklet form by that company. To the discussion which covers resin baking finishes, their properties and uses prior to the war, wartime applications, induction heating, application of continuous induction heating to pipe line coatings, and wartime specifications for resin baking finishes has been added illustrative matter in the way of a diagram, a chart and photographs.

★ In a four-page illustrated folder Wheeler, Osgood Co., Tacoma 1, Wash., introduces Laminex plastic faced plywood, a new material said to combine the desirable characteristics of plywood and plastics. This material is made by permanently welding a plastic impregnated fibrous coating on phenolic resin bonded plywood under heat and pressure to form panels. Physical properties of the new substance are shown in a table on the last page of the pamphlet.

★ "E" series horizontal injection molding machines now in production in 12-, 16- and 28-oz. sizes are covered in bulletin 620-C received from Watson-Stillman Co., Roselle, N. J. Included are specifications and blueprints of the completely hydraulically operated machines, as well as a fairly complete description of their outstanding features.

★ A detailed description of the extrusion of sheeting with the use of a circular die is presented in a revised and enlarged edition of "Tenite Extrusion" prepared by Tennessee Eastman Corp., Kingsport, Tenn. Described in the booklet is the forming of Tenite by the dry-extrusion process into strips, tubes, rods, monofilaments, sheeting and various profile sections. The detailed discussion is accompanied by diagrams and blueprints showing typical designs of dies for continuous extrusion, equipment for extruding sheeting and rolls for sheeting.

★ A "Plastics Primer" by Durez Plastics & Chemicals, Inc., North Tonawanda, N. Y., presents in brief simple form some interesting facts about phenolic plastics. After distinguishing between thermoplastic and thermosetting materials, the booklet charts phenolic compounds and their properties, illustrates some of their applications and discusses industrial and oil soluble resins. (*Please turn to page 188*)



This gentleman is going to have the privilege of seeing with his own eyes the miracles of tomorrow. Wouldn't you like to swap places with him? You cannot, of course, but the rapid accomplishments of science in recent wartime years help us partially to visualize America's infinite opportunities for advancement in generations to come.

CHEMCOT — purest commercial form of cellulose — will take a vital part in future scientific development. Now used as the standard base for plastics, rayon, and scores of other cellulose products, CHEMCOT will be applied effectively in development of "miracles of tomorrow."

CHEMCOT CHARACTERISTICS:

- **CHEMCOT is the purest commercial form of cellulose (99% plus).**
- **CHEMCOT is processed to your exacting specifications.**
- **CHEMCOT is the standard base for cellulose products requiring strength, uniformity, color and clarity.**
- **CHEMCOT is also a base for fine paper, paper products and the like, where brilliant permanent whiteness, cleanliness and absorbency are desirable.**
- **CHEMCOT is the sole product of this company; thus, through concentration of the skill of its technical and production departments the highest quality of cellulose is assured.**
- **CHEMCOT is produced in two forms — sheeted and bulk — affording wide versatility of application.**

SOME PRESENT USES

Adhesives	Glass, Non-Shatterable
Casings, Sausage	Insulation
Celluloids	Lacquers
Coating Agents	Laminated Products
Cotton, Absorbent	Leather, Artificial
Diapers, Disposable	Linoleum
Dynamite	Napkins, Sanitary
Fibres, Vulcanized	Paper
Films	Paper Products
Filters	Plastics
Finishes, Textile	Polish, Nail
Floc (Suede Finishes)	Powder, Smokeless
Foils, Transparent	Rayon Yarns

WE DO NOT MANUFACTURE FINISHED PRODUCTS, BUT PRODUCE PURE COTTON CELLULOSE FOR USE IN A WIDE VARIETY OF PRODUCTS.

Your inquiries are invited. Write for samples of CHEMCOT, sheeted or bulk.

SOUTHERN CHEMICAL COTTON COMPANY

CHATTANOOGA 10, TENNESSEE

CHEMCOT
PURE COTTON CELLULOSE

New Machinery and Equipment

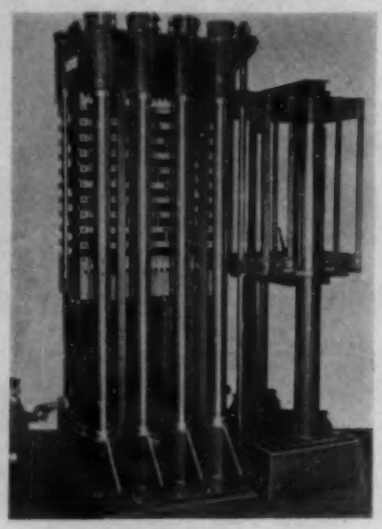
★ An electronic timer suitable for applications requiring highly accurate circuit timing has a double receptacle permitting two circuits to be timed simultaneously. Electronic Controls, Inc., Newark 4, N. J., produces the new interval timer whose time range is from 1 to 120 sec. in increments of one second with an accuracy claimed to be better than 5 percent. Plastics molding, production control, tumbling barrels, industrial ovens and mixers are a few suggested uses.

★ An insulated variable temperature and humidity chamber recently developed by Tenney Engineering, Inc., Newark 5, N. J., is designed to test batches or parts under standard or variable conditions. Temperature, humidity and air circulation can be controlled to close preselected limits in laboratory or production testing operations.

★ A hydraulic press featuring continuous dial feed and automatic ejection of the parts has been announced by Hydraulic Machinery, Inc., Dearborn, Michigan. Powered by a Hy-Mac hydraulic power unit housed in the base, the press operates on either single or repeat-cycle. The automatic cycle is accomplished by hydraulic sequence valves, solenoid operated four-way valves, pressure switch and limit switch, as well as a special electrical control panel. In the operation cycle the

part is fed to the press manually and the Cycle-Start-Button pressed. This indexes the part to the work station, the work ram moves down and the ejection ram moves up unloading the part in the chute or conveyor. The work ram and ejector ram return. When set on repeat-cycle the press operates continuously.

★ A 10-opening, 2700-ton steam platen press designed for laminating, curing and polishing plastic sheets to uniform thickness and surface finish is manufactured by



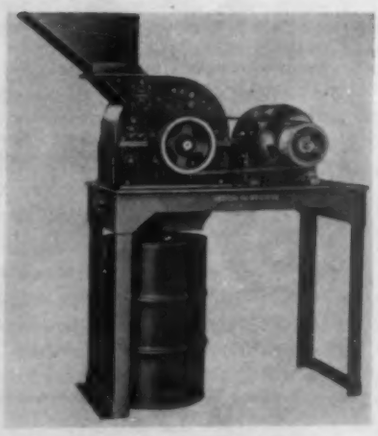
R. D. Wood Co., Philadelphia 5, Pa. Featured in this unit is a quick loading and unloading mechanism incorporated as a part of both the press and the elevator (patents pending), which make possible the moving of the material in and out of the press without its sliding over or in any way contacting the polished platen surfaces. The press can also be furnished as a completely self-contained unit and in capacities up to 7500 tons with steam or electric heated platens as required.

★ E. W. Bliss Co., Brooklyn, N. Y., has developed a 250-ton semi-automatic self-contained press designed particularly for the plastics trade. Patented guides for the slide provide for accurate guiding, at the same time permitting expansion of the slide. Other features include sequence control and independent timing of the preliminary cure, the gassing period and the final cure.

★ The "Mighty Midget," diminutive electric furnace, is a decided departure from accepted laboratory and small unit production furnaces, according to K. H. Huppert Co., Chicago 37, Ill., the manufacturer. Measuring only 3 by 3 by 3 in. I.D. and $8^1/_2$ by $10^1/_2$ by $8^1/_2$ in. O.D., the unit is equipped with a built-in, precision automatic control that maintains any desired temperature in the furnace range (200 to 1750° F.). This precision control which balances power input to heat demand is said to lower operating costs considerably.

★ A new Holtite "Tap" screw recently announced by Continental Screw Co., New Bedford, Mass., is said to cut deep, smooth, clean threads in plastics without chipping the material around the edge of the hole or bulging the perimeter upwards. Fundamentally, the screw is a narrow two-fluted tap with the normal core of metal between the flutes cut out, giving ample chip clearance, which is said to eliminate binding and reduce driving torque and effort. The mating threads cut in materials by this tap screw leave no space between threads, as is the case when machine screws are used in holes threaded by a tap, thus reducing loosening vibration.

★ Plastic scrap of any size, shape or nature may be uniformly granulated to the homogenous granules needed for even mold flow through the use of the American "KC" rotary knife chopper recently developed by American Pulverizer and Crusher Co., St. Louis 10, Mo. In a once-through, fast, single operation the new machine is said to reduce cellulosics, styrenes, acrylics, polyethyls, butyrates



and vinyls, yet maintain control of granule size, even with materials which soften at temperatures as low as 40 to 50° C. Uniform granulation is achieved by the clean-shearing action of three adjustable, hardened tool steel cutter blades, affixed to a heavy balanced rotor, as they revolve past stationary knives in the reduction chamber. The machine which occupies a floor space of only 36 by 72 in., has a capacity of 200 to 400 lb. per hour.

The man who looks at Fastenings

--and finds missing profits for you!

--the P-K Assembly Engineer

"HOW TO USE" booklet — FREE on request—will get you acquainted with P-K Self-tapping Screws and other Fastening Devices—if you are not yet ready to see a P-K Assembly Engineer. Ask for Booklet No. 480.

With profits diminishing in the squeeze between fixed selling prices and higher labor costs, every production department is on the spot to produce savings in the only way left — by short cuts in operations to eliminate every unnecessary work-hour.

If your job is assembly, the P-K Assembly Engineer can help you find plenty of missing profits that now are wasted in needlessly high costs.

He may make a brief study in your assembly department and show you where operations like tapping, nut-running, riveting, or inserts in plastic can be eliminated. Or, when desired, he will put your assembly through a complete fastening survey in the P-K Laboratory.

The results, in product improvement and lowered costs, are often amazing. For example, a P-K Assembly Engineer showed one manufacturer with a large contract for electrical equipment how to use P-K Screws, eliminate molding in 1,000,000 brass inserts in plastic cases! Savings in work-hours of 30% to 50% are common.

The P-K Assembly Engineer will call at your request, without obligation. You'll find his advice unbiased, because P-K makes *all* types of Self-tapping Screws. If you prefer, mail in assembly details for recommendations. Parker-Kalon Corp., 208 Varick St., New York 14, N. Y.

PARKER-KALON P-K SELF-TAPPING SCREWS

FOR EVERY METAL AND PLASTIC ASSEMBLY

News of the Industry

★ The Virginia-Lincoln Co. has sold its entire Marion, Va., plant to Brunswick-Balke-Collender Co., according to Charles Lincoln, president. The Lincoln brothers are now forming a new company, Damascus Furniture Corp., which will have its offices in Marion and plant in Damascus, Va. The new company will take over the patent structure, trademarks, all plastics techniques, as well as laboratory and engineering personnel of the Virginia-Lincoln Corp.

★ Pittsburgh Plate Glass Co., Pittsburgh, Pa., has recently announced the appointment of Harry W. Gleichart as director of sales for the Columbia Chemical Div. In the same announcement, John C. Lepport was named assistant to the operating vice-president of Southern Alkali Corp., Corpus Christi, Tex., which is owned jointly by Pittsburgh Plate Glass and American Cyanamid & Chemical Corp., New York 20, N. Y.

★ Robert P. Kenney, recently in charge of technical service for B. F. Goodrich Chemical Co., Cleveland, Ohio, is now manager of international sales, according to a recent announcement made by the company.

★ Access to a resorcinol resin glue supplied by Casein Co. of America, division of Borden Co., New York 17, N. Y., under the name of Cascophen, has been granted to civilian trade as a result of reconversion and increased supplies of raw materials, according to a recent announcement. The newly released product is said to be notable for its ability to develop a boil-proof, completely durable phenol resin type bond at ordinary room temperatures. Its strength makes it adaptable for joint assembly, gluing thick laminations and everyday shop work.

★ Clifford P. Setter, former chief of the plywood and veneer branch of WPB, has been appointed vice-president and chief administrative officer of U. S. Plywood Corp., New York 18, N. Y.

★ Baldwin Locomotive Works, Philadelphia 42, Pa., has announced the appointment of Robert G. Allen as general sales manager.

★ Eugene Heston has been recently named to the position of plastics machinery sales manager for National Rubber Machinery Co., Akron, Ohio.

★ The first of a series of Paraplex resins, Paraplex G-20, has been made available on a commercial scale, according to an announcement by Resinous Products & Chemical Co., Philadelphia, Pa. This product is a permanent, non-oxidizing plasticizer for nitrocellulor coatings, and also can be formulated to give compounds of a rubbery nature which do not embrittle at a low temperature.

★ Hercules Powder Co., Wilmington 99, Del., has revealed plans for the construction at Parlin, N. J., of a new laboratory which will serve as headquarters for development and research work for its plastic operations.

★ Reduction of fire hazards in lacquered surfaces on aircraft is made possible through the use of the new lacquer Skylac, introduced by Monsanto Chemical Co., St. Louis 4, Mo. Developed for fabric-covered exterior control and plane surfaces, and interior decorative areas, the finish is said to combine increased weather resistance, high tautening effect and ease of application with high fire resistance.

★ A. W. Nelson of Rada Products, Chicago, Ill., who engaged in metal stamping during the war, is planning the establishment of a fully equipped injection molding department which should be ready for operation about the first of the year.

★ A new plant is being constructed at Cornelia, Ga., for the Lumite Division of Chicopee Mfg. Corp. of Georgia. This plant will be devoted exclusively to the weaving of Lumite plastic fabrics.

★ Announcement has been made by E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Del., of the appointment of Dr. George De Witt Graves and Dr. Robert Emmett Burk as assistant chemical directors of the Plastics Department. The company has also made public the retirement of John A. Burckel as special assistant to the general manager of the Plastics department.

★ Dr. Earl W. Flosdorf has recently resigned his position of assistant professor of bacteriology in the Medical School of the University of Pennsylvania to apply his full time to the duties of director of research and development for F. J. Stokes Machine Co., Philadelphia 20, Pa.

★ In line with its extensive program for peacetime expansion, Athol Mfg. Co., Athol, Mass., has announced the appointment of Thomas P. Milligan to the newly created post of sales promotion manager. Under his direction, the new department will focus especially upon product development and promotion of Terson vinyl resin coated fabrics.

★ Dr. F. K. Schoenfeld, technical director of B. F. Goodrich Chemical Co.'s development laboratory, Cleveland, Ohio, has announced the appointment of George W. Flanagan as manager. Mr. Flanagan was formerly in charge of Geon latex development for the company.

★ Richard H. Malamphy, recently co-owner of the Homalite Co., Wilmington, Del., has joined Polyplastex, Woodside, N. Y., to serve in the capacity of manager of development.

★ American Hard Rubber Co., New York 13, N. Y., has announced the purchase of the Saran Div. of Hodgman Rubber Co., and has established an entirely new plastic division.

★ Dr. Francis D. Frary, director of Research, Aluminum Co. of America, Pittsburgh, Pa., has been elected to receive the Perkin Medal, according to an announcement made by the American Section of the Society of Chemical Industry.

★ Foster W. Berry, former chief of the wood and plastics unit of Inspection Div., Army Air Forces, has now joined the staff of Engineering Associates, St. Charles, Ill. Mr. Berry will engage in research and industrial development.

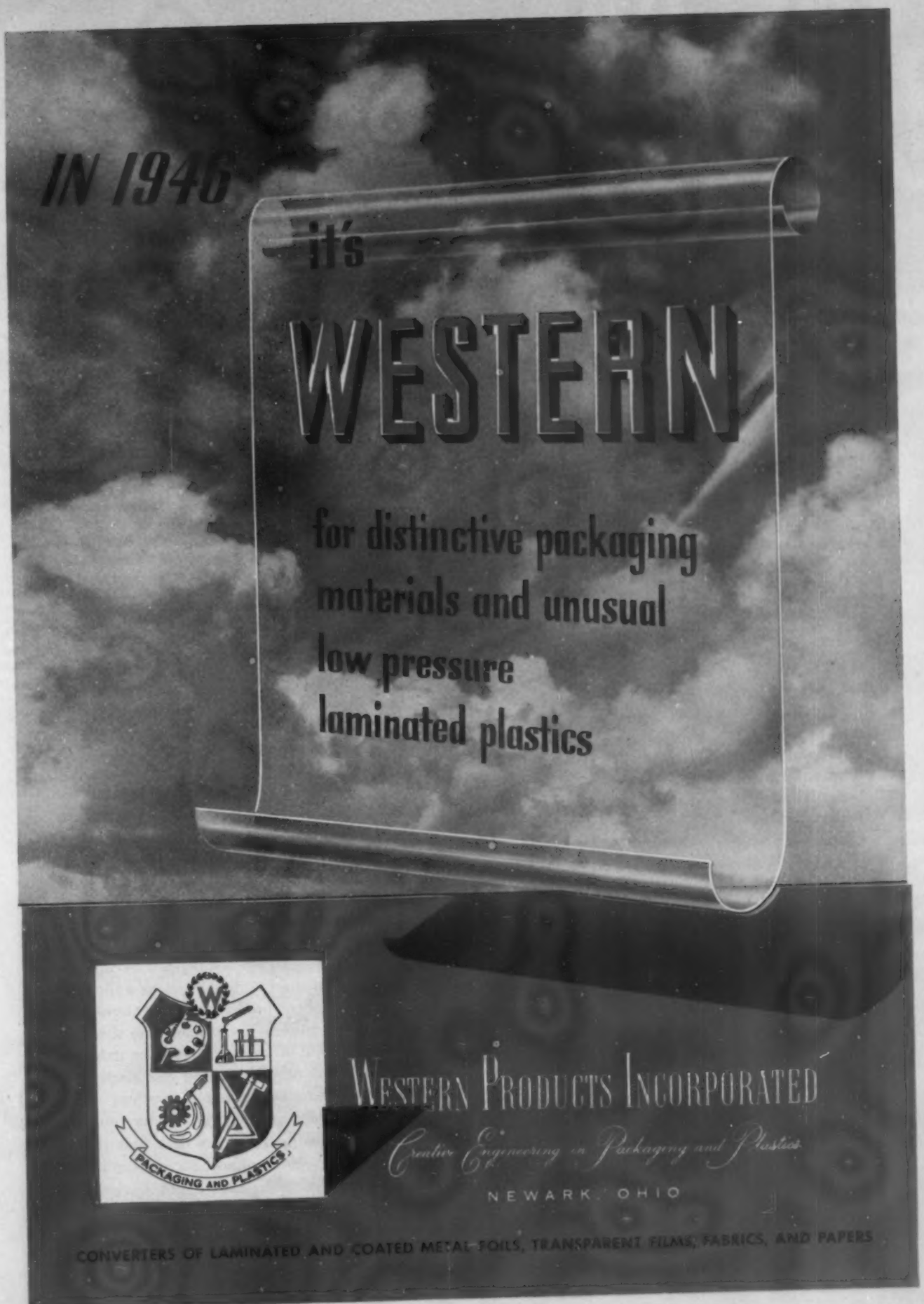
★ Dunne Rubber Co., Ashtabula, Ohio, has recently taken on the molding of plastics by compression, transfer and injection molding.

★ F. J. Riehl has formed Putnam Tool and Die Co., Zanesville, Ohio, to design and manufacture injection and compression molds exclusively for the plastics industry.

★ Alfred C. Manovill, formerly with Plastic Manufacturers, Inc., Stamford, Conn., has joined Ideal Plastics Corp., Long Island City 1, N. Y., as general manager of the Button and Novelty Department.

★ Dr. William A. Mosher has resigned his position as technical assistant to the director of research for Hercules Powder Co. in order to accept the position of head of the Chemistry Dept. at the University of Delaware.

★ Recent expansion of the engineering facilities of Plastic Die and Tool Corp,. Los Angeles, Calif., has resulted in the appointment of Kenneth W. Spillman as production engineer.


IN 1946
it's
WESTERN
for distinctive packaging
materials and unusual
low pressure
laminated plastics
PACKAGING AND PLASTICS
WESTERN PRODUCTS INCORPORATED
Creative Engineering in Packaging and Plastics
NEWARK, OHIO
CONVERTERS OF LAMINATED AND COATED METAL FOILS, TRANSPARENT FILMS, FABRICS, AND PAPERS

Books and Booklets

(*Continued from page 182*)

★ An attractive booklet by Dominion Plywoods, Ltd., Southhampton, Canada, is entitled "Design for Tomorrow" and illustrates such varied plywood applications as office panelling, ceilings, doors, window and door trim, dressers, desks, cedar chests, tables, chairs, radio cabinets, window displays, containers and small boats. Both metal covered and decorative laminated plywood are shown, as well as tubing, industrial plywood and a new product named Korbord.

★ Marmix (Marbon S resin in a water dispersion) is described in a bulletin, prepared by Marbon Corp., Gary, Ind. The new substance serves as a reinforcer for synthetic rubber latex compounds such as Marbon S serves that requirement in regular compounds. Samples attached to the last page of the booklet illustrate the effect of varying amounts of the reinforcer when added to GR-S3 and Hycar OR-15 latex.

★ Available knowledge on the nature, occurreace and possible commercial utilization of resins found in coal, particularly the coals of the United States and Canada is summarized in Technical Paper 680 released by the Bureau of Mines, U. S. Dept. of the Interior. The new publication, prepared by W. A. Selvig quotes the results of research indicating that these resins might be used for certain grades of varnish if they were obtainable commercially at low prices. A copy may be obtained for ten cents from the Superintendent of Documents, U. S. Govt. Printing Office, Washington 25, D. C.

★ "Sanding and Finishing with Modern Coated Abrasives," published by Carborundum Co., Niagara Falls, N. Y., gives fairly complete coverage to the subject. Eighty-six pages of photographs, tables, charts and text give data on the different types of abrasives, their outstanding properties and instances where each is employed to best advantage. Separate sections are devoted to the chief industries where abrasives have an important place.

★ Milling machine arbors and accessories are catalogued in the new edition of publication M-1424 just released from Cincinnati Milling and Grinding Machines, Inc., Cincinnati 9, Ohio. To the original edition have been added complete lists of arbor collars; drawings and dimensions of arbor support bushings, spring chucks and collets; dimensional drawings of Nos. 40, 50 and 60 series taper shanks to increase the booklet's value.

★ "Resinite" tubing, tapes and tying cord fabricated from thermoplastic synthetic resin compounds are covered in a pamphlet issued by Resin Industries, Santa Barbara, Calif. Properties of the compounds are charted in this booklet which describes the various forms, dimensions and uses of the resin materials.

★ A new edition of the "Thermocouple Data Book and Catalog" has been issued by Wheelco Instruments Co., Chicago 7, Ill. The bulletin gives complete information on selecting proper thermocouples, on aids for installation and on prices, and presents recommendations on the choice of thermocouple protecting tubes, connectors and plug and socket assemblies.

★ An illustrated catalog from Bissett Steel Co., Cleveland, Ohio, gives data on tool steel tubing for the purchasing agent, tool engineer, production manager, plant superintendent and metallurgist. Among the applications pictured in this booklet are a blanking and forming die, slitter rolls, slitter blade and boring jig bushings.

TAKE ANY FLAT OR CYLINDRICAL PATtern—it can be a shape cut out of a sheet of metal, an embossed seal, a photo-engraving or a line cut—and press it into a sheet of wire mesh; use the impressed mesh as a male or female embossing die or as a printing plate on either a cylinder or a flat bed. There you have surface forming on sheet material by a new process, patented by Edgar C. Oldofredi, Oldofredi Research Laboratories. It will work on plastics, paper, foils, leather, coated fabrics, ceramics and textiles.

PHOTO, COURTESY OLDOFREDI RESEARCH LABS.

No commercial applications of the process have yet been reported but many are in the course of development. The mesh dies, usually made of phosphor-bronze wire, can be of any thickness or weave. Being light, they do not need the amount of pressure used in embossing with solid metal dies and because of this can be used to impress an indented design into one side of a thick sheet of material while leaving the other side unimpressed. They can be wrapped around a cylinder or used flat and have already been proved in long production runs.

Since they need such low pressures in use, wire mesh dies are likely to become popular in embossing large areas of sheet material such as wallpaper and decorative sheet products. A "watermark" effect may be obtained by placing one sheet of mesh on each side of the material to be marked. A wire mesh die may be heated electrically for burning a design into sheet material such as wood.

The inventor has molded clay under pressure against wire mesh and he considers that it has possibilities in plastics molding, but on thin molding materials the mesh holes might have to be plugged by plating or some other means. It is also suggested that color could be wiped across a plastic surface embossed by wire mesh dies, in this way providing two-color effects.

Sav-Way Presents

The Pacemaker

A Precise and Efficient Laboratory Press

★

One and Two-Ounce Capacities

★

Designed for Experimental, Educational, and small Production Use.

Sav-way

The Pacemaker injection molding machine is designed particularly for experimental, educational, and limited production use. It is a precise and efficient laboratory press, ideally suited to research, development, and instruction. It is a perfect press for making small scale pressing tests, preparation of samples, and testing single cavity molds. An important advantage is the small amount of material required for the pressing operation, and the elimination of waste. Available in 1-ounce and 2-ounce models.

Complete technical details of the Sav-Way Pacemaker will be furnished upon request.

SAV-WAY INDUSTRIES

BOX 117, HARPER STATION, DETROIT 13, MICHIGAN

A year in plastics engineering

(*Continued from page 135*) uum is applied and maintained from 23 to 28 in. of mercury for 30 to 60 minutes. This treatment removes all air from the interstitial spaces. The vacuum is then bled and resin admitted to the sealed chamber where a pressure ranging from 150 to 300 p.s.i. is maintained for from one to three hours. After removal from the impregnation chamber, the preforms are air-dried, then oven dried in order to remove moisture and volatiles to a point desirable for proper molding.

A typical flash-type mold (Fig. 17) such as is used in the compression molding of phenolic materials is satisfactory for this type of work.

Foamed plastics

Much has been written about foamed plastics,[11, 12] but the July issue carried the first complete article describing a production sandwich structure job in which the inner and outer skins of the sandwich were bonded by a plastic foam.[13] This structure was a radome designed and produced to protect the radar equipment on the Grumman F-7-F Twin Engine Night Fighter. When assembled in position on the plane, it became the nose of the fuselage. Due to its location, great strength was necessary to resist the shocks from the blast of firing this plane's armament.

In order to produce this structure, an inner and outer skin is molded by usual low-pressure methods from resin impregnated Fiberglas. The outer skin is then placed in a female form and the inner skin on a male form. The two forms are designed so that when nested, the two skins would have a uniform space between them over their entire area.

Before lowering the male form covered with the inner skin into position, the various components of the foamed resin mixture are weighed out and cooled to a safe operating temperature. Next, they are carefully combined in a Hobart-type mixer. In about 5 min. a homogeneous mixture results. This mixture is then poured into the female portion of the mold, after which, guided by the spacing mechanism, the male mold is lowered into position and the two securely locked together (Fig. 20). Heat is applied to both molds and, in a very short time, excess foam material starts escaping through the flash areas. After approximately 15 min. of curing, the molds are cooled. The male mold is then raised and the completed nose lifted from the female form leaving the two skins which are securely bonded into a strong and uniform sandwich structure (Fig. 21).

According to the author of the article in MODERN PLASTICS, this process should find many postwar outlets especially with the manufacturers of low-weight furniture, refrigerators, stoves, household insulation and aircraft.

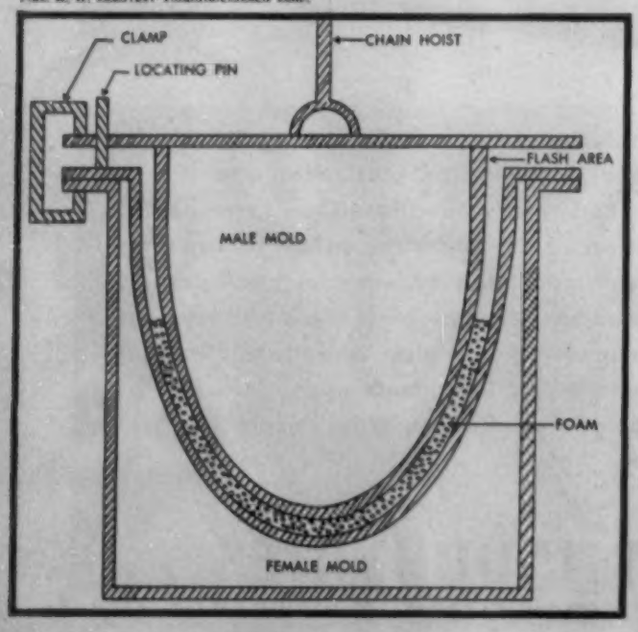
Radar

When all the secrets of radar were released in September, MODERN PLASTICS was invited to attend advance showings and demonstrations of all types of radar which had been used during the war by both the Army and the Navy. A brief history of the development of radar as well as a summarizing report of these disclosures was given in an article entitled "Radio Detection and Ranging" in the September issue. In addition to this history and report, a complete production story of one type of radome was presented. This article, complete with pictures, clearly demonstrated that low-pressure molding techniques could be set up on a straight line production basis. It also indicated the possibilities for strict quality control in the production of this type of plastic part.

[11] Capt. G. B. Rheinfrank, Jr., and Capt. W. A. Norman, "Core material for sandwich structures," MODERN PLASTICS 22, 127–131 (July 1945).
[12] Leonard S. Meyer and John C. Case, "Honeycomb core in sandwich structure," MODERN PLASTICS 22, 136–137 (July 1945).
[13] J. D. Lincoln, Jr., "Sandwich structures with foamed core," MODERN PLASTICS 22, 132–135 (July 1945).

20—A section drawing of the mold for a sandwich structure with a foamed core. The mold shown is in the closed position with the foam beginning to fill space between the skins

FIGS. 20, 21, COURTESY VIRGINIA-LINCOLN CORP.



21—The foamed core sets during curing and in so doing it welds together the inner and the outer skins of the sandwich

STILL *flexible*

— AFTER VARNISHING AND BAKING

Fibron #5373

CHEMICAL AND HEAT RESISTANT

FLEXIBLE PLASTIC TUBING

This new especially formulated Irvington tubing, Fibron #5373, has all the advantages of conventional plastic tubings — plus the ability to remain flexible after varnishing and baking or extraordinary exposure to continuously high temperatures.

PARTIAL TEST DATA ON FIBRON #5373

Tensile Strength	3000 P.S.I.
Dielectric Strength (.020" wall)	
Wet	1000 VPM
Dry	1000 VPM
Life at 105°C.	2000 Hrs.
Chemical Resistance (room temperature)	
50% Surfuric Acid	Unaffected
30% Sodium Hydroxide	Unaffected
Does not support combustion	

Low Temperature Flexibility	
I.V.I. Pinch Test	—40°C.
Bell Test	—30°C.

Heat Endurance (.166" ID tubing, .016" wall) (ASTM-D350-43T)

7 days @ 125°C. — Did not crack when bent 180° around ⅛" mandrel — Retains flexibility after being varnished and baked for 22 hours at 260°F. — No flow or drip during 8 hours at 300°F.

"Look to Irvington for Continued Leadership in Insulation"

Fibron #5373 is produced in all standard colors and sizes — and can be supplied in heavy wall thicknesses — in 36" lengths, continuous coils, or cut pieces. For full particulars, and samples, write Dept. 146 Irvington Varnish and Insulator Co., Irvington 11, New Jersey.

IRVINGTON
VARNISH & INSULATOR CO.
Irvington 11, New Jersey, U. S. A.

Color Blending in the Middle Ages and Now . . .

do it the Exact Weight Way . . .

The colors of the middle ages were beautiful and lasting yet they lacked uniformity. The reason? They were solely the product of individual skill. Color blending today is strictly a mechanical operation . . . . weighing to the fraction-ounce. Color success now is the right equipment for the task. Failure to attain perfect color matching today is almost entirely due to equipment. There are several EXACT WEIGHT Scales for color blending. Fine jobs require delicate weights to 1/1000 oz. . . mass color jobs not so fine. The EXACT WEIGHT Scale for your purpose is expressly fitted to your specifications. What is your problem? Write us for details.

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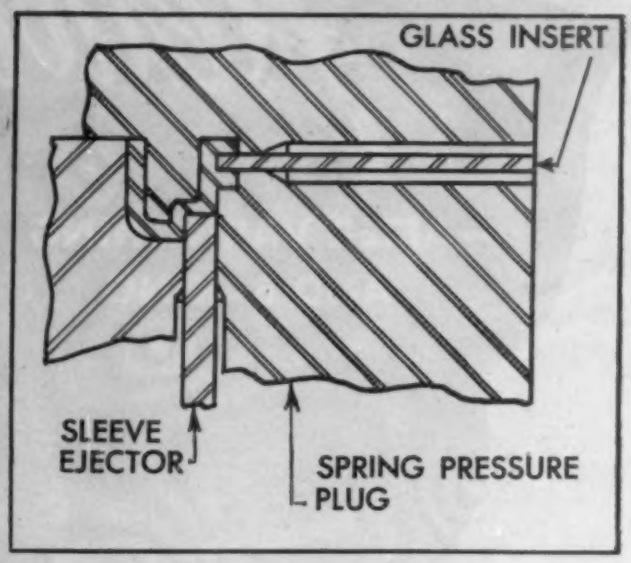
Exact Weight Scales

THE EXACT WEIGHT SCALE COMPANY

650 W. FIFTH AVE. COLUMBUS 8, OHIO
Dept. AC, 783 Yonge St. Toronto, Canada

Design standards for inserts

(*Continued from page 154*) in. shrinkage per inch, the material will shrink 0.032 inch. If the same insert is pressed in after molding and only 0.016 in. is allowed for anchorage, there will be no danger of cracking.



27—A second type of mold for use in the production of a stepped part with a molded-in glass insert

Both diamond and straight knurl give satisfactory results in pressing in inserts. In certain instances, for special applications, a coating of adhesive may be applied on the insert to help anchorage and assist in obtaining an airtight joint.

XX. "Don'ts" in insert design

1. Don't use inserts if they can be avoided.
2. Don't mold a through-type insert unless the mold is designed for it.
3. Don't use an open-hole insert if it can be avoided.
4. Don't leave sharp corners on inserts. Chamfer wherever possible.
5. Don't mold inserts without proper anchorage.
6. Don't flatten inserts if the insert is loose on the retaining pin.
7. Don't put material into the insert to hold it on the retaining pin. This will require retapping.
8. Don't use inserts unless they are clean.
9. Don't use drawn-type eyelets unless necessary.
10. Don't allow too thin a wall of plastic on back of the insert. A thin wall will bulge up and appear like a blister caused by undercure.
11. Don't allow too thin a wall of plastic around the insert because the plastic will crack.
12. Don't design the part or insert until the correct plastic has been selected. (*Please turn to next page*)

Color Gets Preference

Our reaction to color is instinctive. Color attracts us . . . makes one object more desirable than another. You can use color in plastics without incurring additional finishing costs . . . color is an integral part of the plastic material.

Nixon

C/N CELLULOSE NITRATE

C/A CELLULOSE ACETATE

E/C ETHYL CELLULOSE

Plastics

NIXON NITRATION WORKS

NIXON • NEW JERSEY

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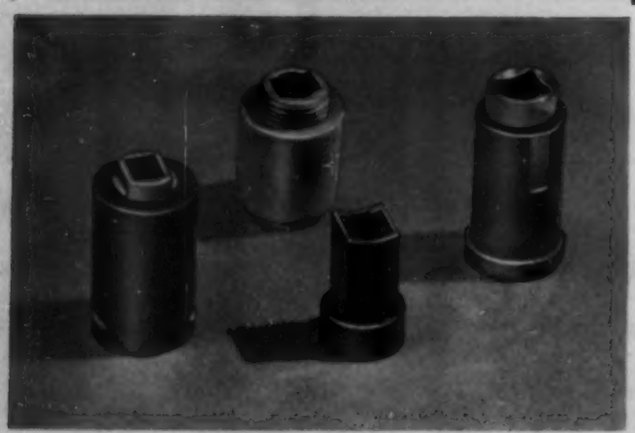
COTTON DUCKS
FOR
LAMINATED PLASTICS

Curran & Barry
ESTABLISHED 1903
320 BROADWAY NEW YORK 7, N. Y.

SKILLED AND TOOLED FOR PRECISION MOLDING

Brush Holders...



Custom Molded Plastics engineered by Midwest, consistently measure up to exacting specifications and requirements. Address your inquiries to MMM, confident that you are consulting an organization skilled and experienced in precision techniques for the production of plastics.

Midwest Molding
AND MANUFACTURING COMPANY
331 NORTH WHIPPLE STREET • CHICAGO 12

13. Don't carry the knurl to the edge of the insert.
14. Don't try to mold long inserts by supporting one end only.
15. Don't mold large inserts in either thermosetting or thermoplastic materials without heating the insert before molding.
16. Don't make the retaining pin too large or the hole for the male insert too tight. This will result in inserts pulling out of the material.
17. Don't use standard nuts and screws.

XXI. Nomenclature

Through-type . . . The insert is exposed on both sides of the material.

Blind-hole . . . . Hole that is not drilled entirely through.

Open-hole . . . . . Hole is drilled through the insert.

Blind-hole, partial thread . . . . Thread is counterbored from the front for terminal or other assembly fit.

Protruding type . . Part of the insert protrudes from the molded material.

Eyelet type . . . . Part that protrudes from the material is used for spinning over in assembly.

Rivet type . . . . . Part that protrudes from the material is riveted in assembly.

Usual type . . . . Inserts that are common to the plastics industry.

Anchorage . . . . Part of the insert that is molded inside of the plastic and held fast by the shrinkage of the plastic.

Retaining pin . . . Pin on which insert is placed and located prior to molding.

Floating of insert . When pressure is applied on the mold and the material softens, it flows upwards. If the insert is loose on the retaining pin, some of the material flows under the insert or into the anchorage points and carries or flows the insert off the retaining pin.

Crushing of insert . When a protruding insert is molded in a conventional mold without any protection, it will be crushed or collapsed by the material which flows into the hole provided for the protruded part in the upper part of the mold.

Flow of material into the insert . . If a threaded open-hole insert is being molded, the retaining pin does not prevent the material from flowing into the insert unless the retaining pin is threaded which increases cost of molding.

Sealing diameter . . Diameter of insert which is free of knurl and allowed to enter the mold to prevent the flow of material.

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(*Continued from page 164*)

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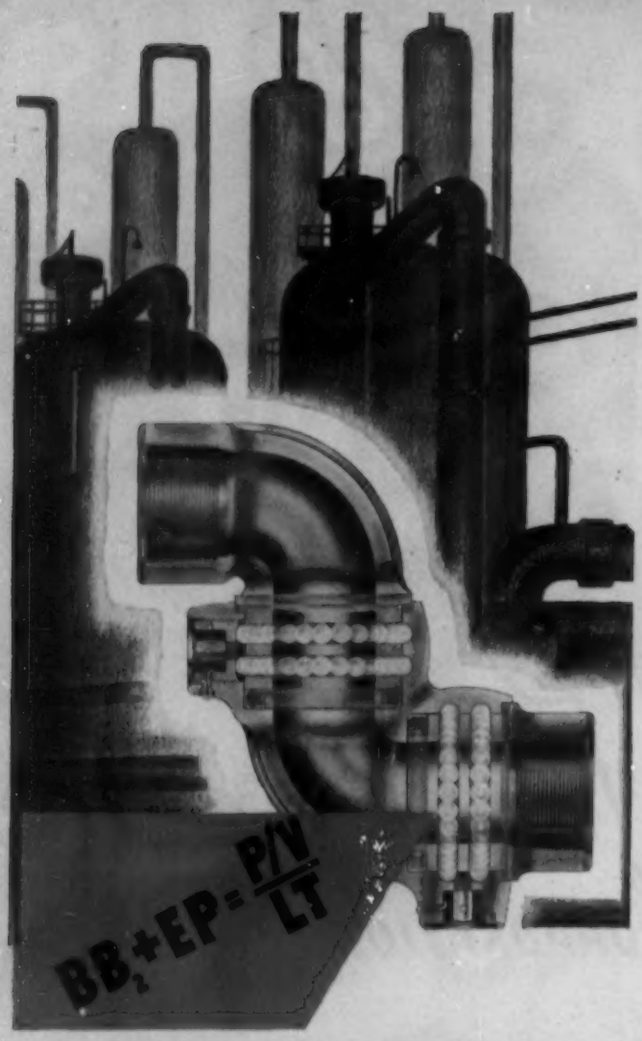

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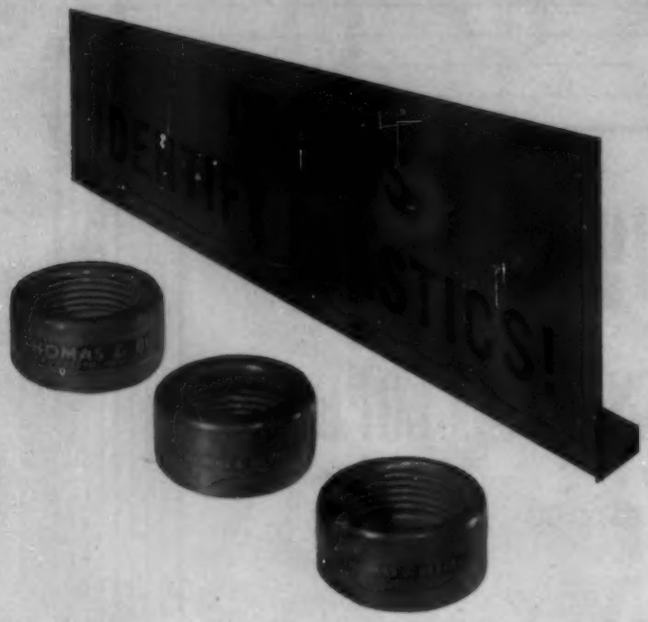

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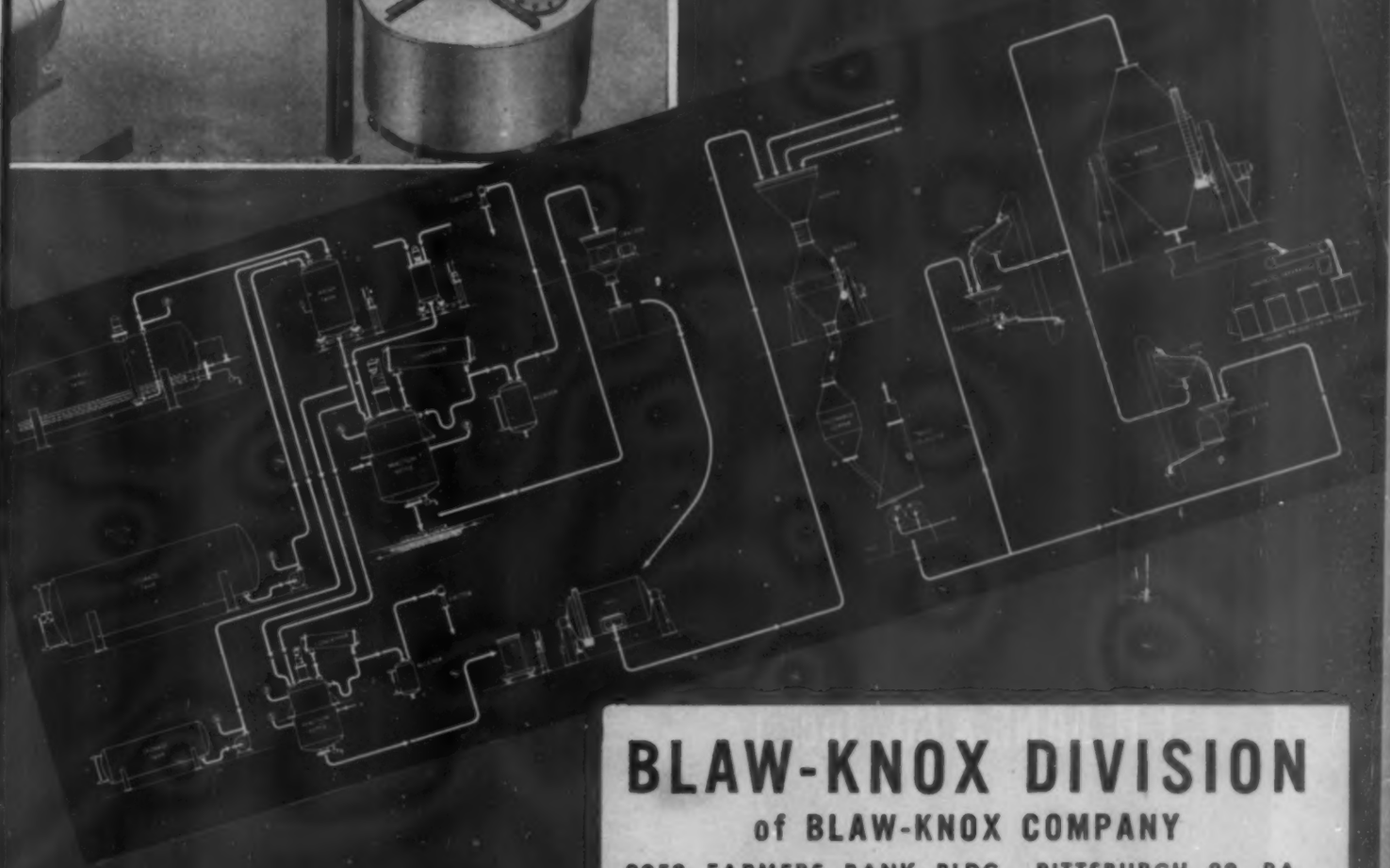

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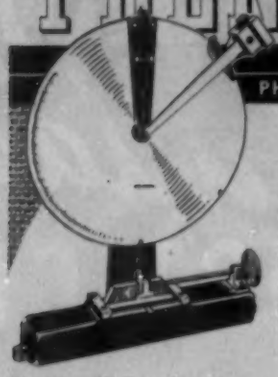

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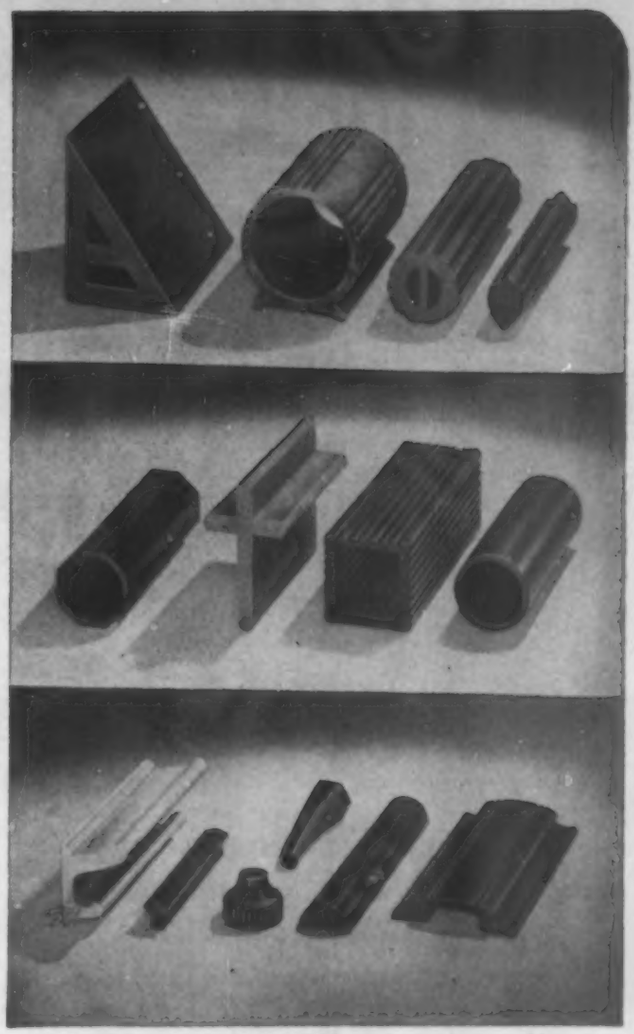

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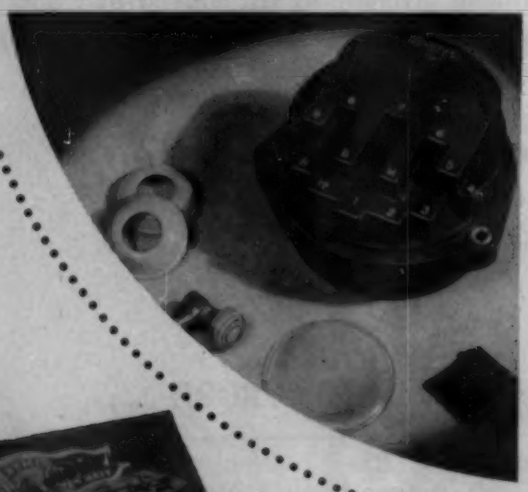

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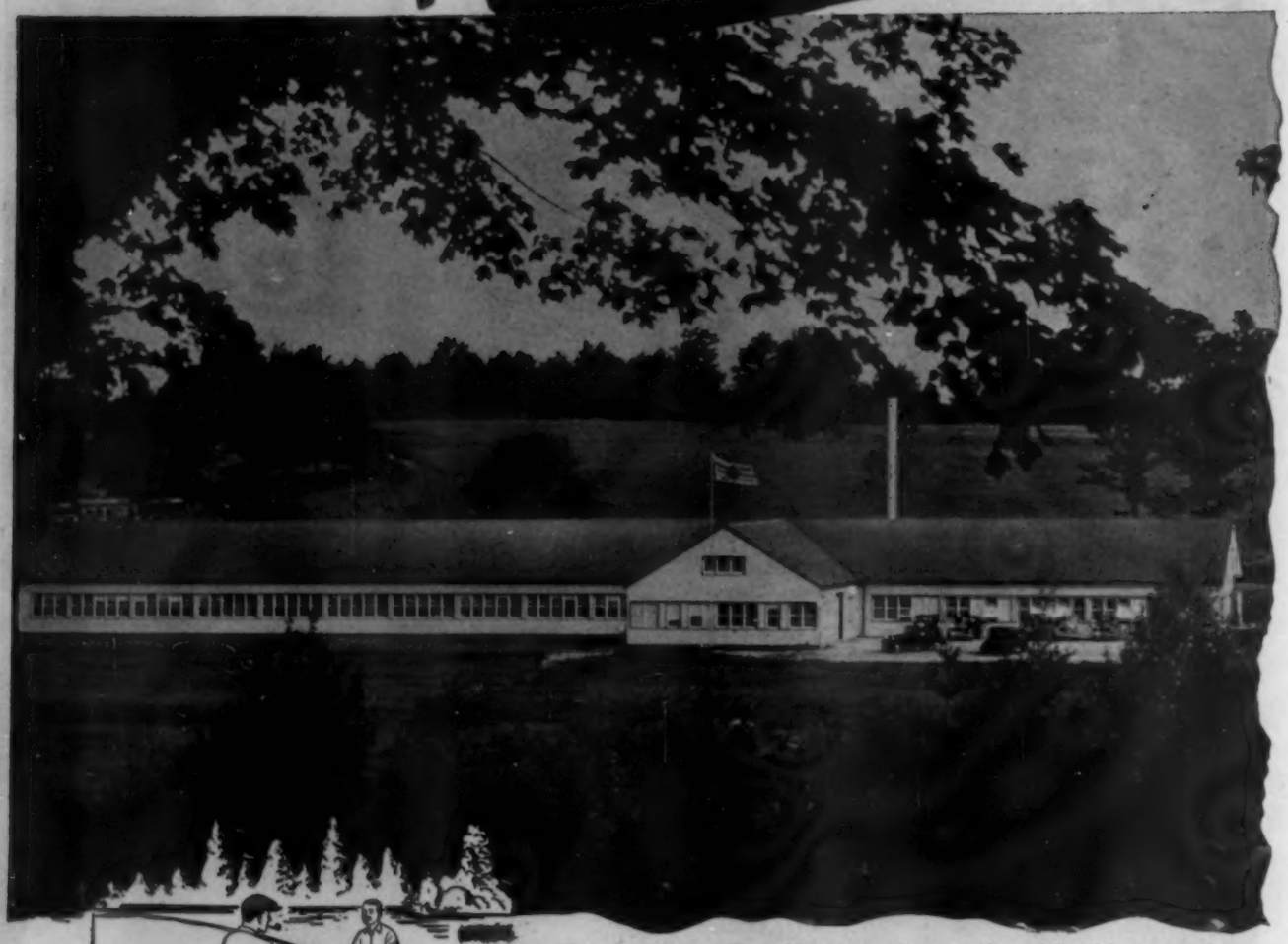
Whether you make or use plastics equipment it will pay you to insist on it being Timken Bearing Equipped and to see that the trade-mark "TIMKEN" appears on every bearing that goes into it. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN
TAPERED ROLLER BEARINGS

Superb Living Conditions Mean

Dependable Personnel

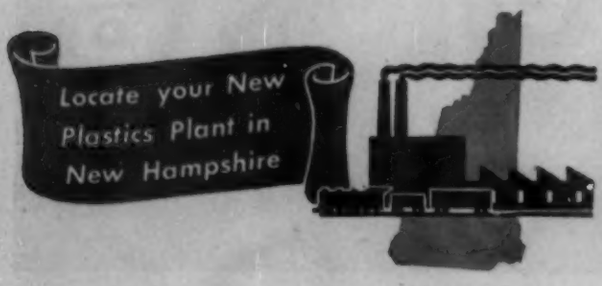


Home-owning New Hampshire people take naturally to industrial occupations.

LOCATE your Plastics Plant in New Hampshire. Where people live well in pleasant, uncrowded surroundings, they work well. Accustomed to industrial work through many generations, home-owning New Hampshire people take naturally to special skills — they are unusually adaptable.

Low power rates and excellent transportation add important reasons for industrial location in New Hampshire. Splendid highways kept open the year around help industry to keep humming every working day in the year.

***Write** for booklet, just printed, "A Plant In New Hampshire." Address Edward Ellingwood, Industrial Director, 31 State Office Building.*



NEW HAMPSHIRE

State Planning and Development Commission

CONCORD, New Hampshire

Advertiser's intensive poll rates Modern Plastics as its industry's **No. 1** *publication:—*

123 to 6

As a guide in charting the course of his advertising budget, the Advertising Manager for a well known plastics machinery manufacturer recently submitted a questionnaire to a selected list of 189 names—chiefly customers.

From 138 responses . . . 123 checked Modern Plastics as the industry's No. 1 publication—two of the other five specified publications receiving only 6 and 3, respectively.

So that so overwhelming a margin of publication leadership might serve as a beacon to all other budget builders, Modern Plastics sought and secured the questioner's permission to publicize the results.

As we see it, the reproduced figures do not require the support of any additional sales copy.

MINIMUM CIRCULATION: 15,000

modern plastics

The Meeting Place **MAGAZINE** *of Plastic Minds*

PUBLISHED BY MODERN PLASTICS Inc., 122 EAST 42nd STREET, NEW YORK 17, N. Y.

Chicago • Cleveland • Los Angeles

Member Audit Bureau of Circulations (ABC)

CIBANITE

A

SPECIALIZED PLASTIC

FOR INDUSTRIAL AND

ELECTRICAL USES

ANILINE
FORMALDEHYDE
RESIN

•

THERMOPLASTIC
MOLDING POWDER

HIGH DIELECTRIC VALUE
HIGH TENSILE STRENGTH - LOW LOSS FACTOR
LOW WATER ABSORPTION
EXCEPTIONAL ELECTRIC STABILITY
GOOD MACHINING PROPERTIES

Literature available on request

CIBA PRODUCTS CORP., 77 River St., Hoboken, N. J.

FOR TROUBLE-PROOF STEAM FEED TO YOUR PRESSES

A battery of multiple platen presses equipped with Flexo joints.

—use FLEXO JOINTS

Single and multiple swing joints—with the flexibility of hose and the strength of pipe For conveying steam or air to your presses. No constrictions to change pressures Foolproof . . . no packing — no springs — no small loose parts — just 4 simple ingenious parts. Completely dust-tight and corrosion — resistant.

For pipe sizes ¼" to 3".

Write for Bulletin No. 166

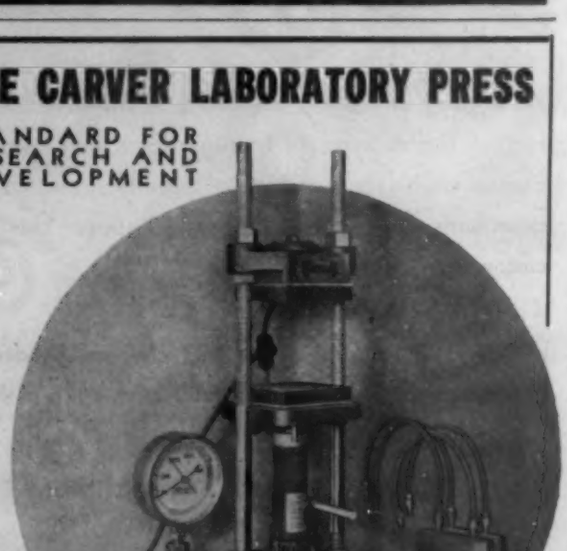
FLEXO SUPPLY COMPANY, Inc.

4213 Olive St. St. Louis 8, Mo.

In Canada: S. A. Armstrong, Ltd., 115 Dupont St., Toronto 5, Ont.

THE CARVER LABORATORY PRESS

STANDARD FOR
RESEARCH AND
DEVELOPMENT



Known thruout the Plastics Industry by its Characteristic Design

FRED S. CARVER
HYDRAULIC EQUIPMENT
343 HUDSON ST. NEW YORK 14

You Hold a Winning Hand When KUHN & JACOB *Is Your Plastic Molder*

The K & J trade mark on the plastic part of a product is a sure sign of its unfailing quality. This plastic part has been designed and molded to meet the particular conditions for which it was intended. Within these bounds it will give complete and lasting satisfaction.

It will pay you to confer with us, and determine just what conditions *your* piece will encounter.

ESTABLISHED 1919 — TRADE MARK

KUHN & JACOB MOLDING & TOOL CO.

1200 SOUTHARD STREET, TRENTON 8, N. J.
TELEPHONE TRENTON 5391

Plastic Molding

Sales Representatives: NEW YORK—S. C. Ullman, 56 W. 42nd St. PHILADELPHIA—Towle & Son Co., 18 W. Chelton Ave. Bldg.
NEW ENGLAND—Wm. T. Wyler, 177 State St., Bridgeport, Conn.

DO YOU KNOW . . .

All of the Advantages of Infra-Red Ray Drying with NALCO DRITHERM *Carbon Filament Lamps?*

Remove Moisture from Plastics Quickly and Cheaply with Nalco Infra-Red Lamps

Use Nalco Dritherm Lamps for efficient results . . . available in Inside-Silvered (self-reflecting) or clear glass types.

Learn all of the advantages of the Infra-Red process for plastic dehydration.

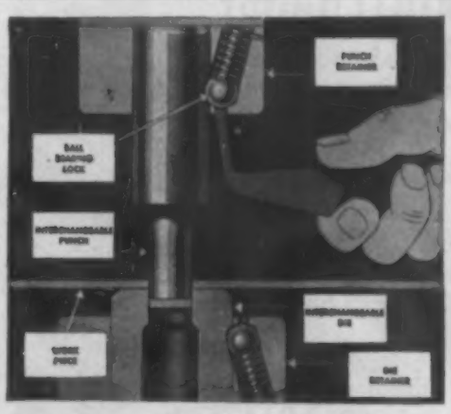
Write for your free copy of "Drying Problems Made Easy" today.

Exterior of Infra-Red Conveyor Belt Tunnel for removing moisture from plastic material prior to molding.

Sides dropped to show arrangement of Infra-Red light bank and materials passing under light conveyor belt.

North American Electric Lamp Co.
1012 Tyler Street St. Louis 6, Missouri

NALCO

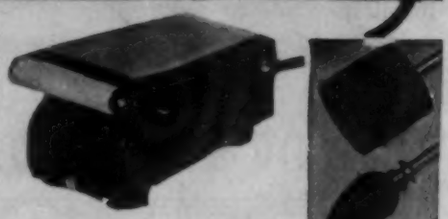


R-B

The Original Inter-changeable Punch and Die

● Allied's R-B Interchangeable Punch and Die lowers costs in the metal working and plastic industries. Standard punches and dies carried in stock. Special shapes and sizes in any material made to your specifications with prompt deliveries. Send for large illustrated R-B catalog, now.

ALLIED PRODUCTS CORPORATION
Department 29E • 4622 Lawton Ave. • Detroit 8, Michigan



Unit F with K handpiece. 1/8 H.P., 20,000 R. P. M. Other Models from 1/20 H.P. to 1/5 H.P. and up to 22,000 R. P. M. 8 Different speeds, rheostat controlled.

FLEXIBLE-SHAFT TOOL FOR MOLD-MAKING AND MAINTENANCE

ARTCO flexible shaft tools are especially designed and constructed for making molds and maintaining them.

Two interchangeable handpieces, Type K with 3/32" and 1/18" collets—Type H with 3/32", 1/8", 3/16" & 1/4" collets enable user to work with more than 1,000 cutting, grinding, polishing tips.

Foot-operated rheostat allows all speeds between 5,000 R.P.M. and 20,000 R.P.M.

ARTCO is the *only* tool of its kind especially designed for use in the plastics industry. As such, it is used in hundreds of plants. Send for Complete Catalog without charge.

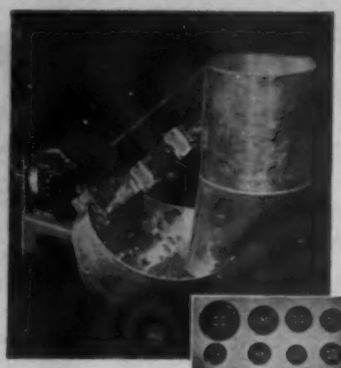
American Rotary Tools Company, Inc.

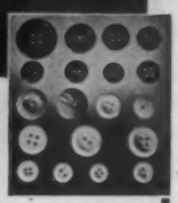
44 WHITEHALL STREET

BOwling Green 9-4895 NEW YORK 4, N. Y.

Automatic Button Finisher

ELIMINATES MANPOWER PROBLEMS





THIS compact automatic machine punches fins and cleans holes of Urea, Phenol and Melamine buttons. Completely automatic it saves countless man-hours of work and performs with perfect efficiency. Can be set & re-set to handle all sizes. 3 models: Model S accepts sizes 12 to 34; Model SP accepts sizes 36 to 50; Model SX accepts sizes 12 to 50. Production up to 450 per minute.

ButtOndeX

CORPORATION

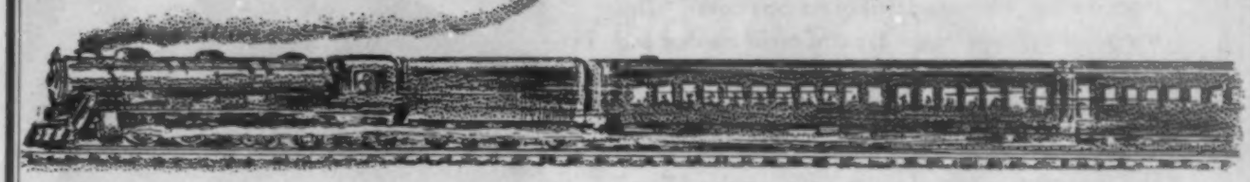
386 FOURTH AVENUE NEW YORK, N. Y.

Plastic Marking

IN GOLD, SILVER OR COLORS

Small Designs, Trade Marks, Names, etc.
Clean-cut precision markings on plastic parts at production speeds up to 1,000 per hour, using unskilled operators. Send samples and details of your stamping problems.
Kingsley
GOLD STAMPING MACHINE CO.
★ HOLLYWOOD, CALIFORNIA ★

YOU'RE GOING IN THE RIGHT DIRECTION WITH *M.H. Martindell*



Get started on the right track in Plastic Molding by using an organization that combines the most modern equipment with the knowledge acquired by its principal over a lifetime of intimate acquaintance with the problems of the molding business. If in doubt, ask MARTINDELL.

MARTINDELL MOLDING COMPANY
North Olden at Sixth
TRENTON 2, NEW JERSEY
NEW YORK OFFICE—1182 Broadway
Plastics PHENOLIC • UREA • CELLULOSE ACETATE MATERIALS

GP
PLASTIC MATERIALS

CELLULOSE ACETATE
CELLULOSE BUTYRATE
STYRENE, VINYL AND
ACRYLIC RESINS

A COMPLETE CONVERTING SERVICE

Capacity and supervision that is a guarantee of quality. . . . A reputation for integrity in every phase of Thermoplastic supply.

Headquarters
THERMOPLASTIC
Scrap
BOUGHT — SOLD
or RECLAIMED *for You*

GERING PRODUCTS inc.
NORTH SEVENTH ST. KENILWORTH, N. J.

DETAIL

Note the fine, intricate detail of the box cover. This is a good example of the type of mold making and molding available at Insulation Mfg. Co. The intricacy of this design can be translated into exact detail for either decorative or industrial moldings.

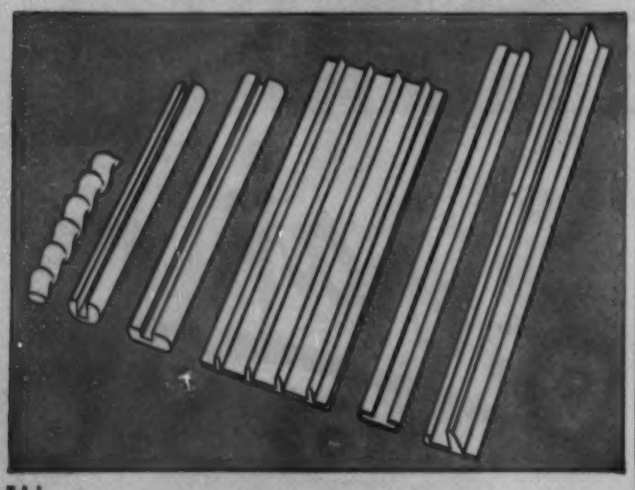
This is another aspect of the molding service offered by Insulation Mfg. Co., one of the reasons why this Company is the chosen source for molded plastics by many of America's leading industries.

We specialize in molding electrical-resistant plastics for Power Companies, Radio and Telegraph stations. We have a large assortment of stock items, as well, including Safety Strain Insulators, terminal blocks and X-ray tube shields.

INSULATION MANUFACTURING CO.

Custom Molders of Plastics for Industry

11 NEW YORK AVENUE • BROOKLYN, N. Y.



• EXTRUDED THERMO PLASTICS

Shapes • Profiles • Strips • Tubes • Etc.

Made to Order ONLY

AMERICAN PLASTICS CORP.

228 West 34th St. New York City 1, N. Y.

Yes, the Cambridge Mold Pyrometer takes the guessing out of surface temperature determination of plastic mold cavities. The use of this accurate, rugged, quick acting instrument will go a long way in eliminating the cause of off colors, soft centers, and out-of-shape in plastics. It is so convenient to use that workers will use it consistently. Write for descriptive bulletin.

Combination and single purpose instruments

Cambridge Instrument Co., Inc.
3711 Grand Central Terminal,
New York 17, N.Y.

CAMBRIDGE
Mold • Needle • Roll
PYROMETERS

Bulletin 194-S gives details of these instruments. They help save money and make better plastics.

Plastics

STOCK MOLDS

SHORT CUT PRODUCTION

Important to every packager is the book of more than 1500 stock molds containing photos of all sorts of items such as caps and closures, electrical parts, boxes, novelties, jewelry and charms, knobs and handles, etc.

Book also contains the only standardized index of stock extrusions including profiles, rods and tubes; also standardized index of laminated sheets, rods and tubes.

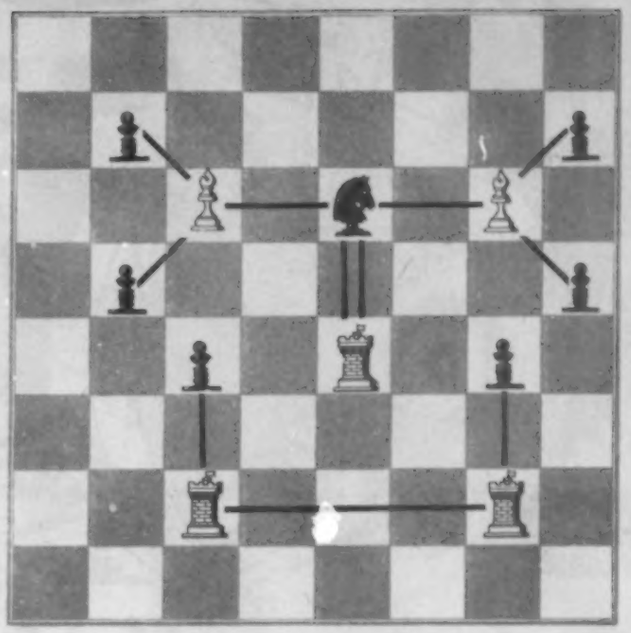
Completely illustrated with photographs and cross-sectional drawings; and indexed with manufacturers names and addresses.

Price **$5.00** (Foreign $6.00)

PLASTICS STOCK MOLDS
122 East 42nd Street, New York 17, N. Y.

DECORATORS
ON GLASS
AND PLASTIC
CONTAINERS
SINCE 1936
★
4 COLORS
IN 1 OPERATION
—FINEST DETAIL

Anigraphic Process, Inc.
11 BROADWAY, NEW YORK 4, N.Y. • WHITEHALL 3-5253



Plan your next move with BECCO UREA PEROXIDE

This is a ridiculous chess-board set-up, but it does represent an excellent formula—Becco Urea Peroxide, a white crystalline material containing 16 per cent active oxygen. It is very readily soluble in water and is also soluble in alcohols and certain other organic solvents. It possesses good storage stability. It contains water-free hydrogen peroxide.

It is available as crystalline powder or as tablets.

A FEW APPLICATIONS:

Used extensively for pharmaceutical and cosmetic preparations. Its outstanding characteristic of containing water-free hydrogen peroxide, makes it applicable as an oxidizing, bleaching and polymerization agent for use in non-aqueous systems.

The available supply of BECCO Urea Peroxide is limited at present.

ACTIVE OXYGEN IS ON ACTIVE DUTY

Other Becco Products:
Electrolytic Hydrogen Peroxide —100 vol. (27.5% by weight)
Ammonium Persulfate*
Potassium Persulfate
Magnesium Peroxide*
Calcium Peroxide*
Zinc Peroxide*
Pyrophosphate Peroxide*
Sodium Carbonate Peroxide*
Acetyl Peroxide*
**Available in research quantities only at present.*

BUFFALO ELECTRO-CHEMICAL COMPANY, INC.

BECCO
SALES CORPORATION
SALES AGENTS BUFFALO 7, N. Y.

Connecticut Plastics

COAST to COAST

No matter what you are at present manufacturing, if it is new—modern—it will likely include the use of custom molded plastics, either in its entirety or as an accessory added for economy, serviceability or purely decorative purposes.

Don't let your custom molded plastics become a problem. Let us advise you—put to your service our vast amount of creative energy and sound production experience gained in the manufacture of custom molded products.

"Call on Connecticut"

Custom CONNECTICUT Plastics Molders

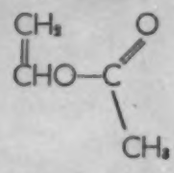
CONNECTICUT PLASTIC PRODUCTS CO.

70 WEST LIBERTY STREET — WATERBURY, CONNECTICUT

UNPOLYMERIZED

VINYL ACETATE

(STABILIZED)



Boiling Range 71.8° to 73°C.

Vinyl Acetate can be polymerized to form resins with exceptional bonding qualities for wood, glass, metal and fibre

Containers:—
410 lb. drums; 62,500 lb. tank cars

For further information write to:

Pearl Essence

Special types have been developed for use with

Cellulose Esters (Acetate, Butyrate)
Cellulose Ethers (Ethyl Cellulose)
Vinylites (All types)
Acrylates (Lucite, Plexiglas)
Polystyrenes

THE MEARL CORPORATION

163 Waverly Place New York, N.Y.

"Ideal" Heavy Duty Scrap Grinder at the Chicago Die Mold Mfg. Company

Illustration shows thermoplastic scrap being ground to re-usable molding powder—the Ball & Jewell Ideal Heavy Duty scrap grinder at the plant of the Chicago Die Mold Mfg. Company. This model is a space saving design, occupying a minimum of room yet sturdy enough to take scrap up to one inch thick. Note enclosed Texrope drive, removable bin and special design baffled hopper preventing accidents and "kick-backs."

• There are 13 models of Ball & Jewell scrap grinding equipment at work in leading plants of molders, extruders, raw material manufacturers throughout the country. They pay for themselves in material saved and reground for use. Three interchangeable screens for different sized granulation with each machine.

Write for free catalog of latest models.

BALL *and* JEWELL

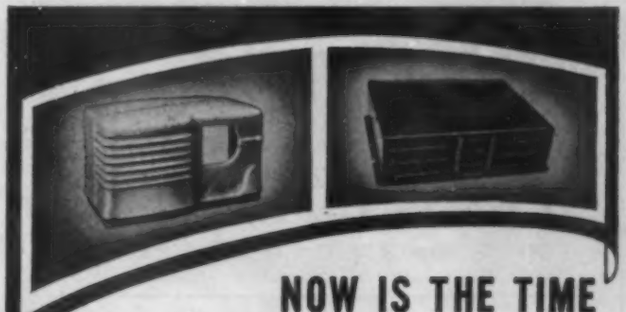
20 Franklin Street, BROOKLYN, N. Y.

Since 1895, Manufacturers of Patent Rotary Cutters

CHICAGO: Neff, Kohlbusch & Bissell. DETROIT: J. C. Austerberry's Sons. LOS ANGELES: Moore Machinery Co. LOS ANGELES & SAN FRANCISCO: Machinery Sales Co. NEW ENGLAND: Standard Tool Co., Leominster, Mass. ATLANTA, GA.: George L. Berry. ST. LOUIS: Larrimore Sales Co. CLEVELAND 22, OHIO: L. F. Willmott, 3701 Latimore Rd. SEATTLE 4, WASHINGTON: Olympic Supply Co. KANSAS CITY, KANS.: Fluid Air Engineering Co. AUSTRALIA and NEW ZEALAND: Scott & Holleday Pty., Ltd., SYDNEY, STOCKHOLM, SWEDEN: Ingenjorsfirman Teknova. CANADA: Williams & Wilson, Ltd., Toronto & Montreal.

HAWAIIAN ISLANDS: Hawaiian Sales Service, P. O. Box 3498, Honolulu, 11, T. H.

This is #13 of a series of advertisements showing typical Ball & Jewell scrap grinder installations in the plastics industry.



NOW IS THE TIME

to start post war planning and working on plastic molded parts Our engineers will be glad to call and discuss any problem having to do with compression or transfer molded parts.

RADIO CABINETS all sizes and other large housings are our specialty

All our molds are made by men with more than thirty years experience. Our engineers offer a similar background of experience. Combined, they guarantee production of highest quality, good looking moldings on the highest possible production basis.

CONSULTATION with our engineers is yours for the asking.

Plastimold, INC.

TRADE MARK

ATTLEBORO, MASS.

SPECIALISTS

INJECTION MOLDING

THE

GROTELITE CO.

INCORPORATED

GRANDVIEW & LAFAYETTE AVE.

BELLEVUE, KENTUCKY

"PIONEERS IN PLASTICS"

ESTABLISHED 1922

WE BUY, SELL, PROCESS

PLASTICS SCRAP

ACETATE BUTYRATE VINYLS POLYSTYRENE ACRYLICS

H. MUEHLSTEIN & Co. INC.

122 EAST 42nd STREET, NEW YORK 17, N. Y.

LOS ANGELES · BOSTON: 31 St. James Ave.

PLASTIC MOLDING . . . *and more!*

Profit by Maico's experience, equipment, complete service!

Injection and compression molding—fabrication—assembly—tool and die making—authoritative engineering counsel . . . all these are available from Maico.

EXPERIENCE? For many years we've been producing plastic parts for our medical electronic instruments. During the war we branched out into many other fields and today we are manufacturing a wide range of plastic items.

Consult us on your plastic plans and problems! Our facilities are at *your* service.

MAICO CO., Inc.
Dept. 551
25 N. 3RD STREET
MINNEAPOLIS 1, MINN.

OPEN CAPACITY *now available*

FOR
EXTRUDING AND MOLDING THERMO-PLASTICS
EXTRUDING CAPACITY UP TO 2½"
INJECTION MOLDING 1 OZ. UP TO 24 OZ.

We Design and Manufacture Our Own Dies and Molds

Manufacturers Sheet, Rod, Tubing and Special Shapes

We Can Mark Any Items in Gold or Colors, Names or Trade Marks.

We solicit your inquiries

HUNTINGTON STAMPING & PLASTIC CO., INC.
P. O. Box 1779
Huntington 19, West Virginia

ORGANIC PEROXIDES

CATALYSTS FOR POLYMERIZATIONS
DRYING ACCELERATORS · OXIDATION
AGENTS · BLEACHING AGENTS

LUCIDOL*
(BENZOYL PEROXIDE)

LUPERCO*
(PEROXIDE COMPOUNDS)

ALPEROX* C
(TECHNICAL LAUROYL PEROXIDE)

LUPEROX*
(PEROXIDE PASTES)

Special Organic Peroxides

* REGISTERED TRADEMARK

LUCIDOL CORPORATION
BUFFALO (5) N. Y.

MOLDS

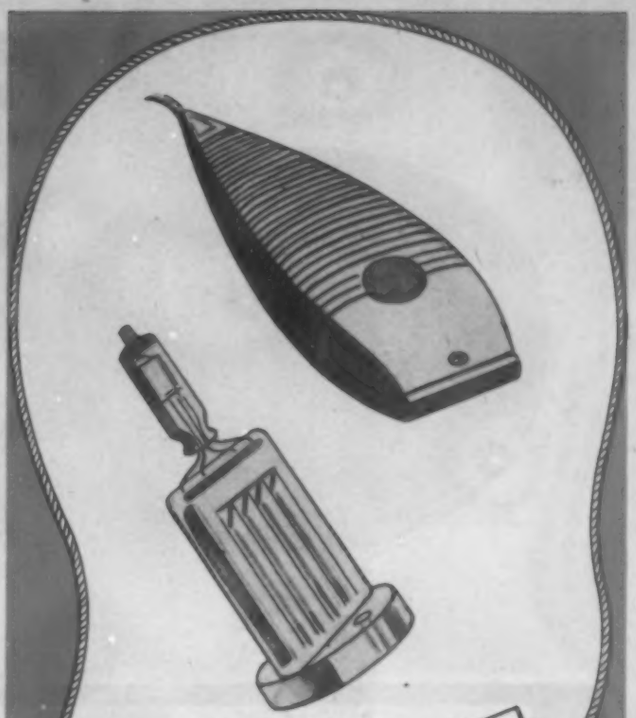
INJECTION

Submit your problems to our experienced engineering staff, equipped to handle your most intricate mold problems.

We design and build automatic molds for many leading molders. Why not let us solve your problems? Our molds are tested before shipping, on our new 16 oz. Lester injection molding machine. . 1911 • 1945

STANDARD TOOL CO.
73-75 WATER STREET
LEOMINSTER, MASS.

N. E. Sales representatives for—
Lester Injection Molding Machines
Ball & Jewell Grinders



There's No Price Tag ON L. H. COOK'S PLASTIC VERSATILITY!

From Radar to Razors, from Signal Corps Telephonic Equipment to Cigarette Cases, L. H. Cook versatility has been proved invaluable . . and it's yours for the asking!

Combined to make New England's most complete small shop, is an extensive plastic mold service, including experimental and development work as well as precision craftsmanship.

Larry Cook cordially invites you to submit your plastic mold problem, whether it's one of design, development or manufacture of any mold, injection, compression, transfer or extruding. No obligation for suggestions, of course. Why not write today?

LAWRENCE H. COOK, INC.
65 MASSASOIT AVE., EAST PROVIDENCE 14, R. I.
TELEPHONE EA. 3881

INVESTIGATE NEW SURFACE DECORATION FOR PLASTICS!

Supplants old methods!

Permanent, Integrall Already in use by hundreds of firms in plastics field. Creative Printmakers new surface decoration process applies all colors to all plastics. Shape and size of molded or fabricated object is no limitation. All decorations applied permanently, bonded chemically with the piece. Used on lipsticks, packages, closures, dials, name plates, advertising premiums and many other items. Guaranteed not to scratch, wash or rub off. Weather resistant. Write for prices and information.

Creative **PRINTMAKERS GROUP**

200 VARICK STREET • NEW YORK, N.Y. • Chelsea 3-6803

Surface Decorators for the Plastics Industry

SARAN by NATIONAL

WEAVING WONDERS IN TEXTILES

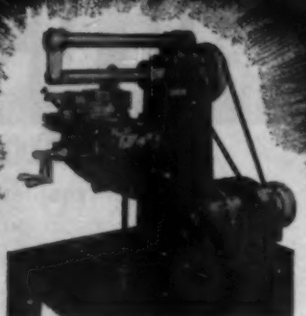
¶ In such applications as upholstry, drapery fabrics, transportation seating, luggage covering—SARAN BY NATIONAL is demonstrating its extraordinary properties. For this tough filament resists dirt, grease, acids . . . can be wiped clean to restore its colorful lustre. And it will wear indefinitely!

¶ SARAN BY NATIONAL is extruded and spooled in the size and color required for every purpose. We do no fabricating, but our facilities are available for the study of your product.

The NATIONAL PLASTIC PRODUCTS *Company*

OSBORN, MARYLAND

ONE BENCH MACHINE FOR *BOTH* HORIZONTAL and VERTICAL Milling



benchmaster mill with horizontal spindle and overarm

FOR PRECISION TOOL WORK OR HIGH-SPEED PRODUCTION

benchmaster — offers a bench milling machine easily convertible from a conventional horizontal to a vertical miller by simply interchanging the spindle attachments.

ACCURATE • VERSATILE • LOW PRICED

SPECIFICATIONS: Table size—6" x 14"—Three Tee slots ⅜", 2" center • Longitudinal travel 8½" • Traverse travel 5½" • Vertical travel 8½" on vertical mill—9½" horizontal mill • Height 28" • Weight (less motor) 215 lbs. • Requires ½ h.p. motor • Spindle speeds (standard 1725 rpm motor) 430-850-1400-2100 rpm.

benchmaster tools *manufacturing company*

2952 w. pico, los angeles 6, cal.

ORIGINALITY WITH ROOTS

Clever in devising forms, assembly and effects in all types of plastics for products, displays and containers. Cleverness that is deep-rooted in long experience, in exceptional facilities and in competent manpower. The kind of cleverness which combines the ability to create with the ability to produce economically, efficently and in quantity. That is the service we have to offer — originality deep-rooted in practicability.

Northern

INDUSTRIAL CHEMICAL CO.

7-11 ELKINS STREET, SO. BOSTON 27, MASS.

A molder you may rely on

If you are looking for a molder who will operate as an integral part of your production—almost like a department of your own plant—whose schedules will mesh with yours, whose production standards are as high as you require—then you may be interested in our compression molding service. Some of the finest names in American industry are numbered among our clients.

SOCIETY OF THE PLASTICS INDUSTRY · SPI

KENILWORTH PLASTIC MOLDING COMPANY

Division of Eureka Button Co. (Est. 1885)

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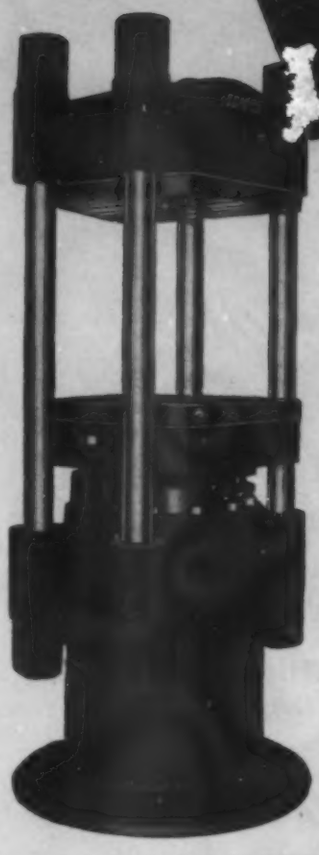

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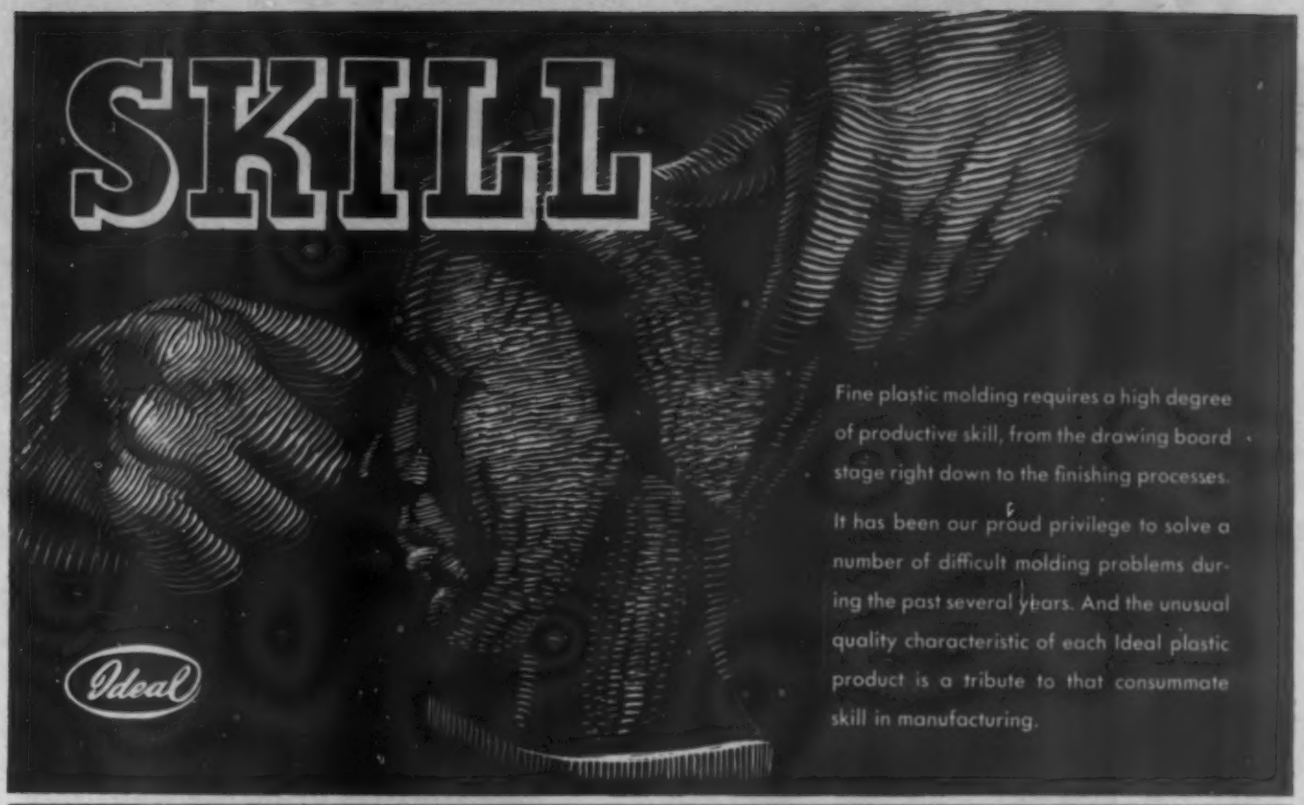
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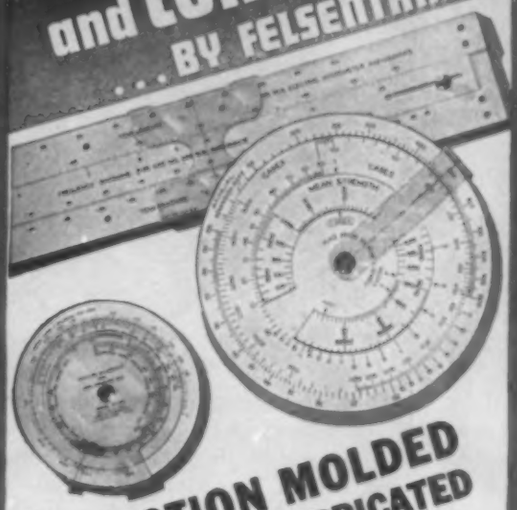

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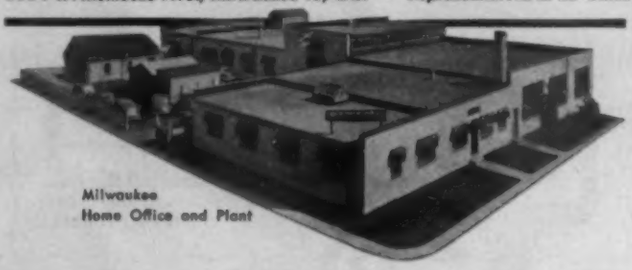
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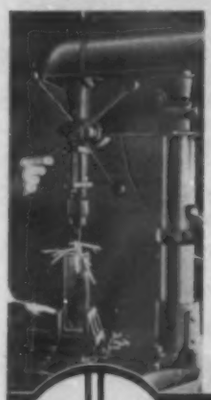

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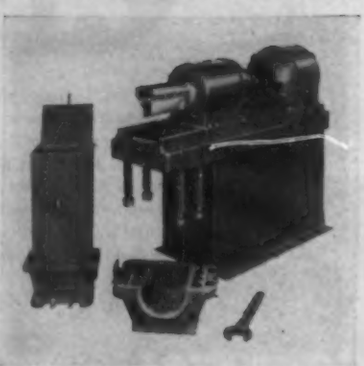

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Branch of the Industry	Name of Appliance	Use
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Molders (Thermo-plastic) Injection	VIBRA-VEYOR (Variable heat)	To preheat plastic powder automatically. To dry plastic powder automatically
Injection	HOPPER-HEATER (Variable heat)	To warm up heavy metal of hopper of molding machine
Molders (Thermo-plastic) Extrusion	STRIP-HEATER (Variable heat)	To preheat strip rolls of vinylite, etc., automatically as fed to worm
Material Manufacturers	Special production equipment including vibrators, conveyors, stainless steel belts and electronic devices	To process various kinds of plastic material in bulk
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WE'RE EXPERTS ON FABRICATING!

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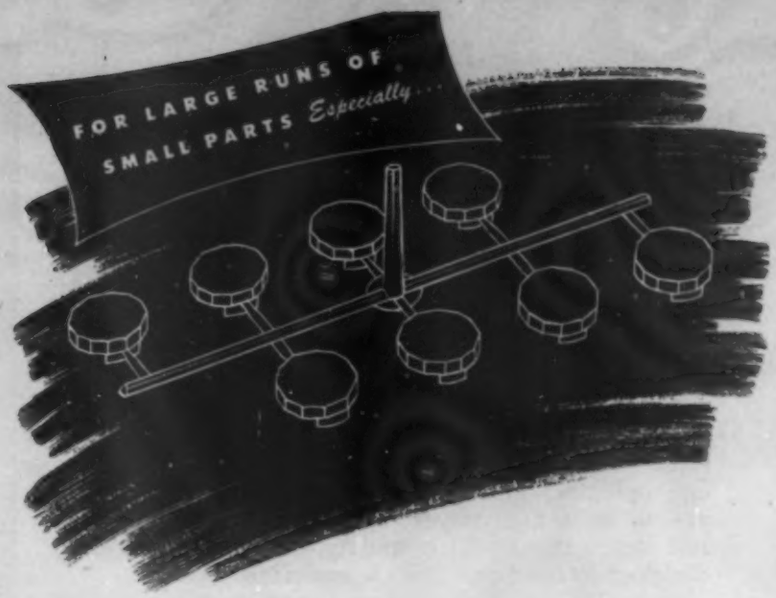

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Lakone knows precision-insert molding . . . knows the painstaking care and technique necessary for molding rugged, securely anchored inserts . . . knows from producing millions of pea-size fine components, the art of handling precision runs, ECONOMICALLY.

LAKONE offers complete engineering facilities from master-made molds to micrometric finish parts. Orders accepted now for on-schedule delivery. Send blueprints for estimate.

Plastic parts by **COMPRESSION:** All types of thermosetting materials: Bakelite, Resinox, Durez.

by **INJECTION:** Styrene, Cellulose, Acetate, Butyrate, Polythene, Ethocel, Tenite, etc.

The Lakone Company

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CONTRACT

PLASTICS MOLDING

INJECTION AND COMPRESSION MOLDING IN ALL THERMOPLASTIC AND THERMOSETTING MATERIALS

We have the set-up and experience to give you the best in plastics molding of small and large parts, in small or large quantities, at reasonable prices.

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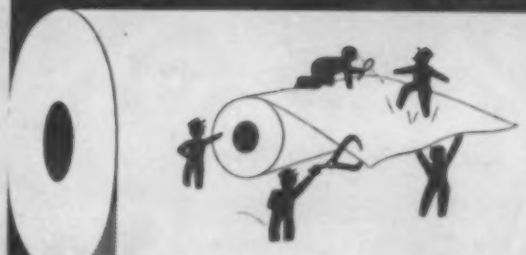
PULP AND PAPERS, CUSTOM-MANUFACTURED FOR PLASTICS APPLICATIONS



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A manufacturer of impregnating papers can make a line of standard stock papers, or he can custom-build papers to meet specific conditions.

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The Munising Paper Company

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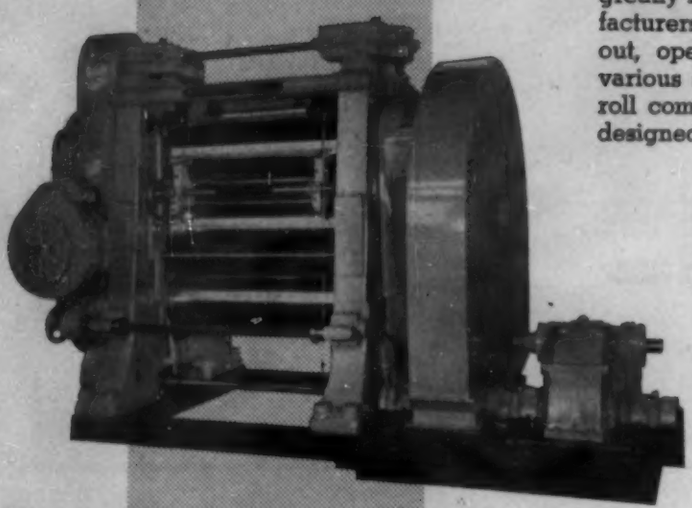
* MANUFACTURERS OF PRECISION MADE PULP AND PAPERS FOR MORE THAN 40 YEARS

Thropp



New Hi-Speed Calenders

THIS new Thropp 3-roll, high speed, heavy duty calender is one of a line of calenders designed to greatly increase production schedules for plastic manufacturers. These calenders are precision built throughout, operating quietly, and smoothly. They come in various sizes, both larger and smaller, and in varying roll combinations. All calenders are custom built and designed to meet customers specific requirements.

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We hold exclusive rights in Patents Re 22,358 and No. 2,335,294, which cover the manufacture of spherical beads by molding a chain of aligned, connected beads and then grinding the chain to remove the connections between the beads to obtain a perfectly round unblemished bead.

Beads made by this process are used in various gem colors for jewelry ornamentation or as cores for the manufacture of imitation pearls.

We will jointly prosecute any infringement of our rights in these patents. It is the purpose of this notice to prevent the unknowing infringement of these patents.

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WANTED: THERMOPLASTIC SCRAP or rejects in any form, including Acetate, Butyrate, Styrene, Acrylic and Vinyl Resin material. Submit samples and details of quantities, grades and color for our quotations. Reply Box 508, Modern Plastics.

WANTED: Small or medium sized plastic molding plant with either hydraulic extrusion or injection equipment with or without tool shop. Advise full details. Reply Box 788, Modern Plastics.

FOR SALE: 1—500 ton Hydraulic Press with downward moving ram and pushbacks. Box 512, Modern Plastics.

WANTED: PLASTIC SCRAP OR REJECTS in any form. Cellulose Acetate, Butyrate, Polystyrene, Acrylic, Vinyl Resin, etc. Also wanted surplus lots of phenolic and urea molding materials. Custom grinding and magnetizing. Reply Box 318, Modern Plastics.

FOR SALE—1—French Oil Hydropneumatic Accumulator; 1 Worthington Hyd. Pump 1 x 6, 5 GPM 6000 pressure M.D. 1—14" x 24" Press, 9" ram; 4—24" x 55" steel cord Heating Platens; 4—W. & P. Mixers; 1—Thropp 10 x 24' Rubber Mill, 1—8 x 13' Rubber Mill; 1—set of 18 x 30" Compounding rolls, reduction gear and motor; 1—Stokes Rotary 32 punch Preform Press; 6—Hydraulic Presses, 20 x 20", 12 x 14"; Allen 6" Tuber; Dry Powder Mixers; Pulverizers, Grinders, etc. Send for complete list. Reply Box 1310, Modern Plastics.

IN THE MARKET FOR: Stainless Steel or Nickel Kettles, Vacuum Pan, Preform Machine and Mixer, Hydraulic Presses. Reply Box 825, Modern Plastics.

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44 pcs.	1/4"	x 36 x 36
34 "	1/2"	" " " "
7 "	2	" " " "
10 "	2 1/2"	" " " "
13 "	3	" " " "

Also other sheets and tubing.
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40 Lispenard St.,
New York 13, N. Y.

CHEMICAL ENGINEER PLASTICS: B.S. 1938 M.I.T. desires position. 7 years experience in development of phenolic-pulp plastics, 5 years in supervisory position. Thoroughly familiar with pulp molding, compression and transfer molding, testing, and product control. Age 30, married, 2 children. Now employed. Eastern location preferred. Reply Box 1412 Modern Plastics.

FOR SALE: Saran O. D. Filament scrap, 10 tons. New Airtronic model C.D. Preheater. Hydr. Press 24 x 24" plat. 11" ram, 38" stroke, 35" daylight. Reply Box 1413 Modern Plastics.

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Capable Sales Organization with 22 years successful merchandising experience will discuss production and distribution with MOULDER HAVING FACILITIES for large volume production of various items. We sell chain, department, variety stores, jobbers also industrials coast to coast. Will make investment for expansion or finance sales or work on commission basis. N.Y.C. office-showroom. Reply box 1442 Modern Plastics.

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Intermediates or compounds selling to industrial and commercial markets.
Our client established 30 years, manufactures to standards of highest quality.
Please write. Communications confidential. We are fully compensated by our client.

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New Products—New Processes

CHILE: American, resident in Santiago, Chile, and returning to Chile January 1, desires exclusive representation for plastic products and machinery. Excellent references. Reply Box 1417 Modern Plastics.

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(2) Plastic Product Design Artists
(3) Plastic Die Designers
WRITE: SKYLINE INDUSTRIES
Molding Division
The Plateau
Meadville, Pa.

Wanted—Position as production supervisor in small established shop or with someone just setting up a plastic department. Have 18 years experience in compression molding and have had 7 years supervisory work in shop. Capable of taking complete charge of all phases of production work. The location is not important, am located in the New York area now. Reference upon request. Reply Box 1419 Modern Plastics.

WANTED: MOLDING ROOM SUPERINTENDENT: Must have full knowledge and experience all phases injection molding, molding materials, injection presses and production equipment. Should be familiar with mold design and construction. Position offers attractive salary and future. When applying state age, experience, references, education and salary desired. Reply Box 1420 Modern Plastics.

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DESIGN SERVICE: Injection transfer and compression molds designed to suit your specifications by experts with many years of experience. We will also design or develop your proposed plastic product to make it suitable for production molding. Reply Box 1426 Modern Plastics.

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WANTED: TOOL ROOM FOREMAN
for established progressive and expanding injection molding place to supervise construction new molds and maintenance of production molding equipment and molds. Opening offers permanent position and future for proper man. When applying state age, education, experience, references, salary expected. Reply Box 1422 Modern Plastics.

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Technical man experienced in transparentizing paper. Ability to work with research chemists and design or assist in the design of equipment for transparentizing papers. Experience more important than age. Give complete information in first letter, including salary requirements. All answers held confidential. Reply Box 1400, Modern Plastics.

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As pioneers in the plastics molding field, Norton's design engineers have the rich background so necessary for rendering competent service to the manufacturer with a molding problem. In addition, Norton's large facilities for compression and injection molding are capable of the inexpensive and efficient handling of any plastic molding job—large or small. Bring your plastic molding problems to a company with a proved record for successful product development service...a company who serves our nation's most prominent manufacturers in practically every field of industry—Norton Laboratories, Inc., Lockport, New York. *Sales Offices. 347 Fifth Ave., New York—9 South Clinton St., Chicago.*

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HERE IS THE MAN YOU ARE LOOKING FOR

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FOR SALE: Micarta canvas base—natural. ¼"—Sheets 48" x 42". Priced for quick disposal. Kelly—2007 Olive, St. Louis, Mo.

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RODS—Paper Base—¾"
STRIPS—Linen Base—466 pcs.—1" x 1½" x 48"
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For Sale: Three used hydraulic oil presses. 200 ton capacity, 36" x 36", 12" ram, 36" stroke, 49" daylight. Price $1250. Eight new hydraulic Vane type pumps, 5 gallons per. min., 2000# P. S. I. Sal-Press Company, 388 Warren Street, Brooklyn, N. Y.

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FOR SALE

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Wanted 42" Rubber Mill complete with drive and motor. Reply Box 1436 Modern Plastics.

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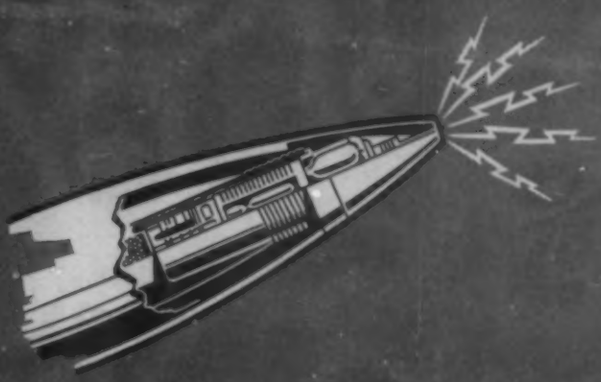

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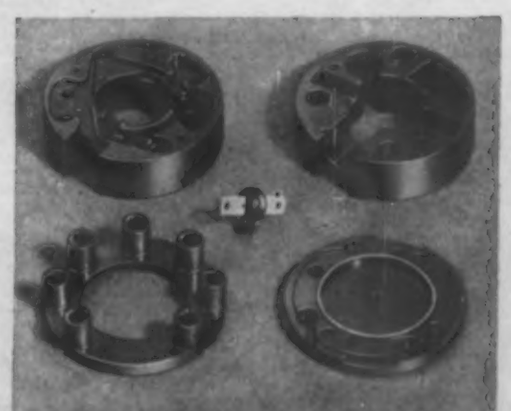

These small but highly intricate plastic pieces are vital parts of the new famous VT fuse.

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Formerly Waterbury Button Co., Est. 1812

DEPT. B, WATERBURY CONNECTICUT

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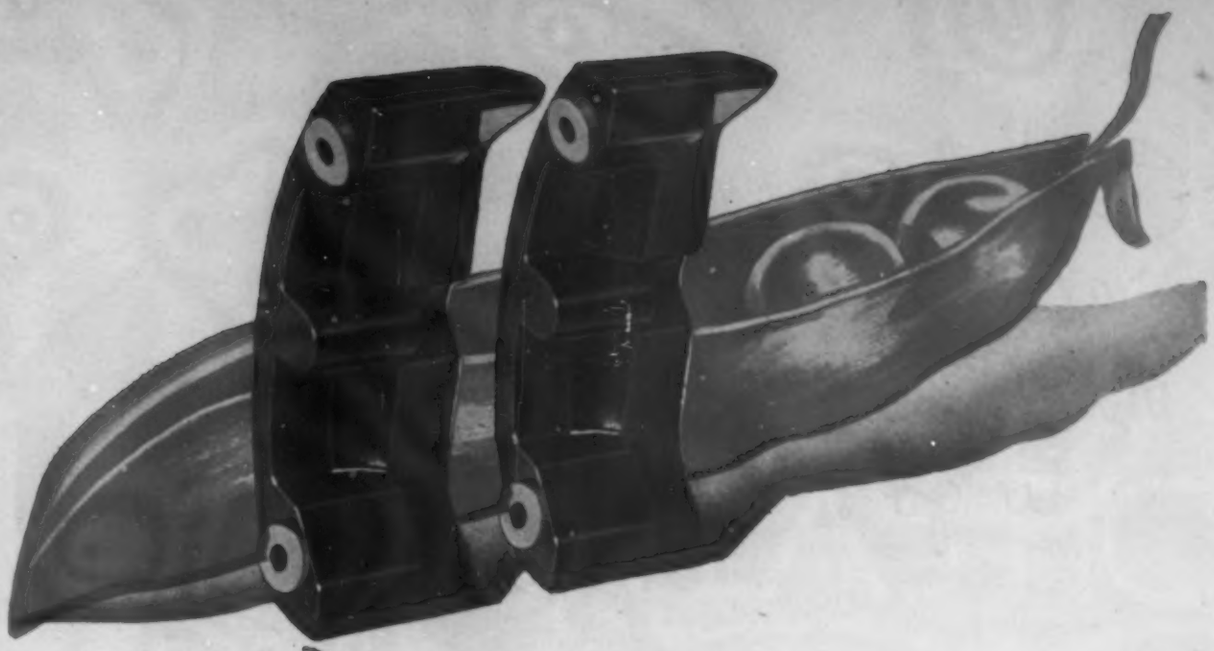

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